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In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

MOTORISTS WISE

SIMONIZ

"Makes the Finish Last Longer"

Your car can never get old-looking if it is Simonized. This remarkable protection fortifies the finish against all wear and weather, makes it last longer, and keeps the colors from fading. Even when a finish is dull, Simoniz Kleener quickly brings its sparkling glory back again. And Simoniz keeps it beautiful for years. Simonizing is easy, safe and economical. It's what all cars need to stay new-looking. So, for beauty's sake, Simoniz your car today.

NEW TOOLS AND MATERIALS FOR

Home-Repair Jobs

Sprayed or brushed on any wood surface, a new oil gives protection against decay and termites

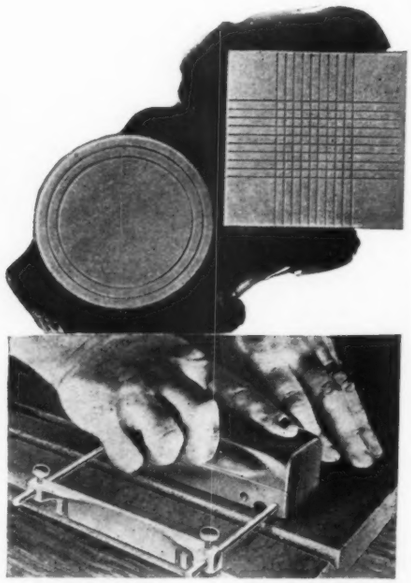
PROTECTION against wood decay and termites now comes in cans. A new concentrated wood oil recently made available makes it possible to add years of life to any piece of exposed wood. Being a liquid and containing the natural decay-resisting chemicals found in living trees, it penetrates deeply into the pores of the wood surfaces on which it is brushed or sprayed. According to its manufacturers, it has four times the insect-killing power of carbolic acid, does not become sticky during hot weather, and will not crack, peel, or be washed away by rain. It contains no caustic and therefore will not burn the skin.

BEVEL CUTTER AIDS IN DECORATING WALL BOARD

RESEMBLING a small plane, a new inexpensive bevel cutter makes it easy for anyone to decorate insulating-board panels used on walls or ceilings. Having two easily adjusted razor-edge blades, it can be used to make almost a dozen different types of V cuts, bevels, and grooves in either straight-line or circular designs. Perfect circles ranging from four to forty-eight inches can be cut easily. Also, when a simple adjustment is made, the tool serves as a slicer for cutting wall board to size, eliminating the necessity of using a saw. The blades are inexpensive and can be replaced as frequently as necessary to provide sharp cutting edges. Made of cast aluminum, the body of the beveler is both light and sturdy. The resourceful home craftsman will find many unexpected uses for this handy tool.

READY-MADE WINDOWS HAVE ALUMINUM FRAMES

PREFABRICATED double-hung window units made of aluminum are among the latest developments in new building equipment. Sold completely assembled, even to built-in sash cords, pulleys, weights, and weather-stripping, they can be installed easily by one man. Because of their construction, they are light in weight, weather-tight, and slide up or down with a finger-tip's pressure. Narrow frames and mullions provide a maximum of light, and yearly finishing is unnecessary.



Bevel cutter in use, and two samples of its work in decorating wall panels of insulating board

PHOTOGRAPHS PRINTED ON CANVAS FOR WALLS

HOME owners who are interested in photography can make use of a new process to decorate the walls of their dens or cellar recreation rooms with giant photographs printed on canvas. Using special materials, it is now possible to enlarge a small negative to give a print covering many square feet. The photograph, actually printed on the wall canvas, then can be colored or left in its natural black-and-white shadings. Striking effects can be secured by this method of decoration, especially by the use of outdoor panoramic views and pictures which contain a great deal of action.

Questions
FROM HOME OWNERS

Q.—WE PAINTED our window frames and sash recently, and now one of the windows is stuck so badly it won't budge. How can I loosen it?—J. H., Baltimore, Md.

A.—Tapping the sash, stop strips, and stool cap (inside sill) with a hammer generally will break the paint film that is holding a window fast. Use a piece of wood to protect the surface.

Concrete for Foundations

Q.—How much sand, gravel, and cement should I buy to make enough concrete to pour a garage foundation having a total volume of 222 cubic feet?—L. S. F., Brooklyn, N. Y.

A.—MIXED in the 1:3:5 proportions suggested for foundations, approximately 4.6 bags of cement, .52 cubic yards of sand, and .86 cubic yards of pebbles or stone will make one cubic yard of rammed concrete. Figured on this basis, your job will require approximately thirty-eight bags of cement, 4.3 cubic yards of sand, and seven cubic yards of pebbles or stone.

Measuring for Wall Paper

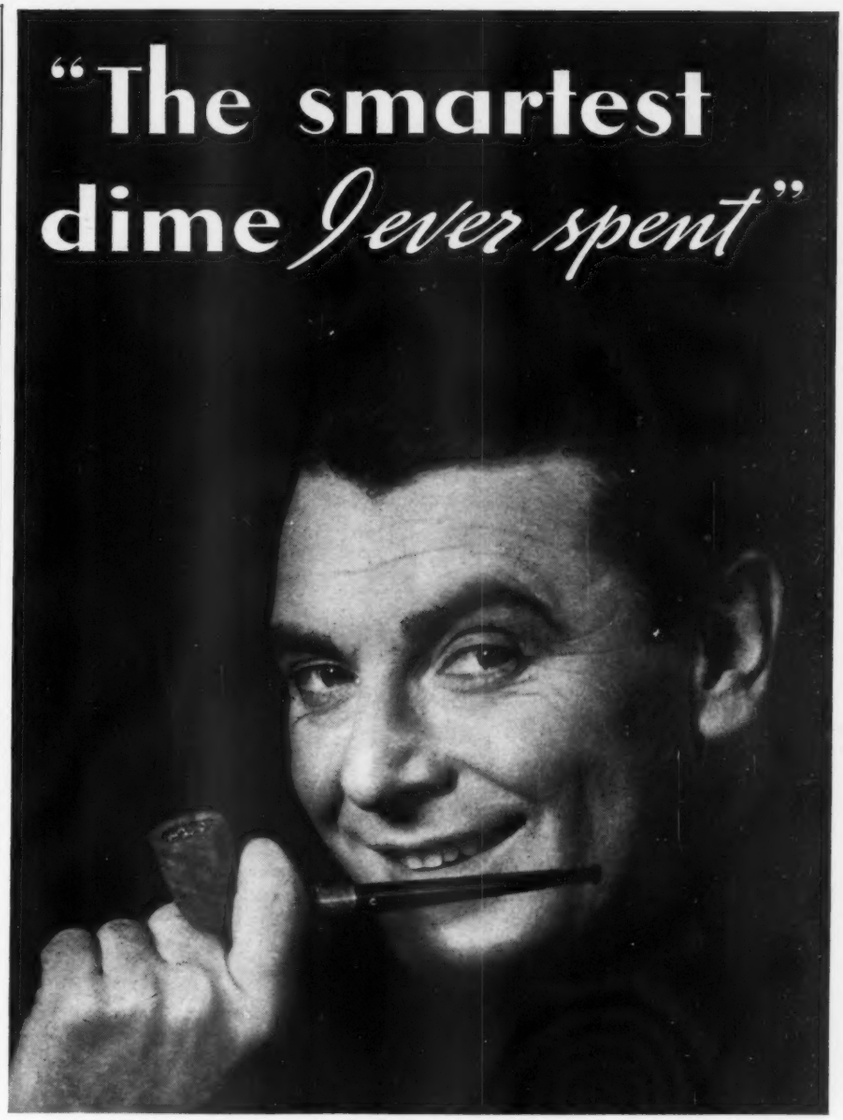
Q.—How is wall paper sold—in what lengths and widths?—R. V. F., Jr., Seattle, Wash.

A.—ALTHOUGH single rolls of ordinary wall paper usually are eighteen inches wide and eight yards long, they often are sold as double rolls—two single rolls joined as one. Special papers, such as duplex, ingrain, and oatmeal, generally are sold in bolts consisting of three single rolls thirty inches wide and five yards long.

Beach Rock for a Fireplace

Q.—I CAN obtain several truckloads of beach rock for nothing. Will this be satisfactory for use in building a rustic fireplace in a small cottage?—W. G., Ontongan, Mich.

A.—IF THE ROCK does not contain too much sandstone, it probably will prove satisfactory, provided it is not exposed directly to the open flame. To protect the stone, line the entire fire box with fire brick or ordinary hard-burned brick, the latter being the less expensive.



GEORGE BRENT, starring in Warner Bros.' picture, "The Goose and the Gander,"
Union Leader smoker since 1925

I'VE smoked long enough to feel that I know something about smoking tobacco. But it wasn't until I tried my first tin of Union Leader that I discovered a dime will buy all the pipe pleasure that any expensive tobacco mixture can give. Fine tobacco is fine tobacco no matter what the price tag reads, and the mellow, *old* Kentucky Burley in Union Leader is *tops* with me. So, why pay more, says I. (Great in cigarettes, too!)

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UNION LEADER

THE GREAT AMERICAN SMOKE

Our Readers Say

Scientists! Stay Away From That Kitchen Door

IN THE newspaper accounts of the recent commercial-plane flight to Hawaii, mention was made of a new kind of self-heating canned food that was carried by the pilots and crew. With this latest gift of science, it seems, it is only necessary to punch a hole in the can; the food obligingly cooks itself by a chemical process of some kind, and comes out piping hot. That's fine — for explorers and travelers. But what's to keep American housewives from hearing about it? Our kitchens have already been modernized into places where there is nothing but a can opener and a stewpan; now we can throw away the stewpan. It's things like this that make a fellow believe in this stuff about a scientific holiday. Let the chemists and the rest of them work on something else, and leave the kitchen with the few old-fashioned virtues it still has.—K.B., Jamaica, N. Y.

Here's Soap Bubble Answer In Black and White

G.P., O.H., and S.S., may not be brilliant physicists but they do seem to be masters of satire. Or are they really being complimentary to their pals of Our Readers Say? Their problem about white soap bubbles coming from dirty water appears rather simple. Water, like any transparent substance, when broken up, splits the rays of light which strike it into all of its frequencies of light. Bubbles, being jumbled, will send all these frequencies into the eye at one time. Singly, bubbles appear colored to our eyes but in a jumbled mixture, the light frequencies being in normal proportions, they appear white. The number of dirt particles in the film of the bubbles is so insignificant that their light rays are not seen by our eyes. The mass of the dirt particles is therefore hidden from our view by the layers of the light-reflecting bubbles.—R. L.B., Elizabethtown, Pa.

Gets Urge to Use Scalpel When Frogs Are Croaking

I AGREE with F.A., of Chicago, that the articles on microscopy should be kept up for years to come. I should like also to see some good articles on dissecting because in the summer frogs are plentiful. If we are given the proper instructions to proceed with such dissecting work, I know that instructive and interesting hours can be spent in carrying it out. The pursuit of this experimental work is inexpensive, yet it affords a valuable elementary knowledge of zoölogy and biology. Such articles would aid embryo biologists.—K.H., Kelowna, B. C., Canada.

A Little Oil Soothes That Sputtering Lead

A. H. A., of Egg Harbor, N. J., asks how to stop molten lead from sputtering and flying (rather, exploding) while being poured from a crucible into a mold. G.T. of Berkeley, Calif., says heat the form. My answer is pour a little kerosene into the mold. A dense blue smoke will rise and then the lead will flow as smoothly and clean as could be desired. Now, maybe some reader can help me with a question I have. What kind of cement can I use to fasten an incandescent lamp bulb into its socket or base? I have a large sun-ray lamp bulb which has become loose and I would like to cement it firmly to the socket.—S.B.K., Youngstown, Ohio.

One Last Snake Letter To End All Snake Letters

You city fellers are too gol-durned cynical. I just happened to see two letters in one of your recent issues, in which readers told of snakes swallowing their young, and blamed if you hadn't decorated the article with a drawing of a sarpint coming out of a jug. No such thing. In spite of the fact that one reader's experience happened forty years ago while the other was more than seventy years back, I can go them one better with something I saw only five years ago. My wife is scared stiff of snakes so when I heard her holler out in the garden one afternoon I guessed the trouble. I grabbed an old cutlass and chased outside. There was a big snake, maybe five feet long. I made a pass at it with the cutlass and chopped it in two a little way from its middle—and then I got the surprise of my life! From inside that snake there came crawling no less than *sixteen* baby snakes from six to eight inches long, as full of life as you please, and they began to scatter all four ways at once. Now whether the mother snake actually swallowed them when she found herself in danger or whether she was just taking them for a ride, I don't claim to know. But I will testify on oath that they were inside of her and that they were all fully formed. And I hadn't had a drop for months, so help me! —R.W.M., Westford, Mass.

Sheik's Dilemma Gives Answer To Half-a-Horse Problem

IN A recent issue of POPULAR SCIENCE MONTHLY, R.B. of Bowers, Pa., asks for the solution of the seventeen-horse legacy problem. Here is the version I have heard. An Arabian sheik died leaving seventeen camels to be divided among his three sons. One was to receive one half, one to receive one third, and one to receive one ninth. When they attempted the division of the camels and found it would not work, they quarreled. A wise neighbor, seeing how things stood and foreseeing that a murder might occur, told the sons he would solve the problem for them. He thereupon drove one of his camels into the courtyard, so that there were now eighteen. He then told each son to take his share. The first took one half or nine; the second took one third or six; the third took one ninth or two. The total of these divisions amounting to seventeen, the wise man drove his camel back home and thus endeth the story.—H.S.R., Norfolk, Va.

A Voice From Down Under Seconds the Motion

READING the plea of J.P., Lafayette, Ind., for larger sailboat plans, I would like to write a few lines in support of that idea. A sloop or yawl, of not less than twenty-five feet and suitable for two or three persons to cruise in, would, to my mind, be just the thing. Sailboats and motor boats are right enough in their way and in fairly sheltered waters, but for real sailing, a good cruiser with a decent cabin takes a lot of beating. As for P.S.M., I wouldn't be without it. The articles on microscopy and radio are excellent.—T.H.P., Currabubula, New South Wales, Australia.

One Instance Where It's Hard To Remain on Top

ONE of the items which amused me in a recent Our Readers Say column was the problem of which part of a wheel traveled the farthest. I wonder how many readers realize that this question was originally a joke. The question was asked in this manner: which part of a wheel travels the farthest, the top or the bottom? The catch in the question is that once the top has moved, it ceases to be the top, and the bottom is no longer the bottom.—R.T.D., Toronto, Canada.

Pastor Solves Tough One— No Mercy for Perpetrator

I HAVE been waiting patiently for some fan to send in the solution of the problem, submitted recently by E. L. M., to find the radius of the base of the frustum of a cone, slant height twenty-four inches, upper diameter, six inches, to give maximum volume to the frustum. My solution gave 21.-81395 feet plus as the radius of such a base. Now, anyone submitting a problem that requires the solution of an equation of the fifth power, ought to be hanged and quartered or be obliged to furnish paper gratis. To solve, just let x equal the radius of the base less

three. Formulate an equation for the volume of the fructum, square it, and differentiate. This will give an equation of the fifth power. Get acquainted with Horner (not little Jack of nursery fame), apply his hocus-pocus on solution of higher equations, and pronto—out comes 18.81395. Add three and you have the answer. Simple; see?—Rev. S.V.F., Aurora, Kans.

Advocates Saving Wear And Tear on Car Owners

I HAVE a suggestion which I hope reaches the attention of some automotive engineer or arouses the inventive mind of one of the column's readers. Frequently before an automobile reaches its first birthday, it becomes necessary to raise the hood and repair some ailing part of the motor. From this point on, the hood-raising becomes more frequent. In making these repairs, you not only have to be able to diagnose the trouble but also to solve the riddle of how to get into a working position to remove a bolt or adjust a set screw. Being a contortionist might help but even then the odds are against your coming through with hands and temper unscathed. Why doesn't some inventive soul figure out a common-sense layout for an automobile motor?—C.H., East Orange, N. J.

If Wheelbarrows Had Motors It Might Be O. K.

As A subscriber of many years to your journal, I appreciate your well-written, illustrated articles on a very wide range of subjects. I am distressed, however, at some of your articles on that detestable practice of vivisection. Apart from the morality of it, is it worth the millions of dollars that have been spent on it? For instance, after fifty years of cancer-research work along these lines the results have been nil. The mortality from cancer has increased and they continue to waste time and money in vivisection work. I reckon it is just as reasonable to ask Gus to experiment on a wheelbarrow in order to find out what is wrong with your car as it is to experiment on a mouse to find a cure for cancer in human beings.—B.McK., Geelong, Australia.

Here's a Recipe to Keep Your 'Hunt-and-Punch' Machine Going

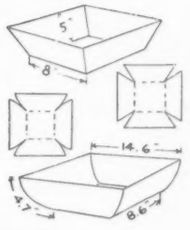
I READ in a recent issue that R.Y., Smithville, Ohio, wants an article on repairing typewriters. No doubt, many readers would like to know how to keep their "hunt-and-punch" machines going. The following may prove to be a helpful first-aid hint. Whenever the tops of the letters print faintly, or do not make the same impressions as the bottoms, the trouble may exist in the roller or in the elevation of the carriage. As a first suggestion, clean the roller with wood alcohol until the rubber seems softer. Better results can be obtained if the roller is removed and filed smooth before cleaning. If this procedure fails, raise the shift key a little and make impressions on the roller with the keys. Whatever height the shift key is raised in order to make even impressions, make necessary adjustments on each end of the carriage for shift key.—J.C.F., Zanesville, Ohio.

Reader Goes Statistical And Gives Us Some Figures

A PUBLICATION of between 300 and 400 pages, with a separate section for each of 101 different subjects ranging from celestial mechanics to the fundamentals of sewing, in addition to the present contents of P.S.M., should satisfy all your readers. The sections could be separated by blank sheets so that squeamish readers would not be forced into contact with any distasteful item. This conclusion was reached after two days' research through Our Readers Say in two dozen issues in which I found that there were requests for items covering 102 different subjects ranging from the construction of seismographs and X-ray apparatus to the strange habits of fish, and animal dissection. The trend of scientific interest, as well as the wide circulation of POPULAR SCIENCE MONTHLY, is shown by the fact that readers from 347 cities in this country and from twenty-five foreign countries were represented in the twenty-four copies of the magazine mentioned above.—S.V.F., East Cleveland, Ohio.

Cutting Corners Leaves Ensign All At Sea

T. W. of New York, in his solution to H.M. of Utica, Mich., overlooked many possibilities in making a receptacle by cutting the corners out of a square of tin so that, when shaped, it would hold the maximum volume. I have drawn two possible shapes which are far from the solution but which give a volume greater than 432 cubic inches. There are an infinite number of shapes that could be made which would give a greater volume by cutting the right shapes out of the corners. To get the exact solution, it is necessary to set up an integral equation in calculus in terms of the dimensions and the volume and the eighteen inches as the limit of the square; the solution of the roots to be such that the volume reaches a maximum as a limit. Attention is called to the intersection of two curved surfaces and the laying out of the proper curves for the cutting of the corners to complete the solution. This I'll leave to brain trusters.—Ensign C.A., U.S.S. Mississippi.



Don't Be Scared To Tackle That Dust-Covered Organ

I'M GLAD A.D.C. of Detroit asked for an explanation of organ principles. Hundreds of these musical instruments are gathering dust in attics because of some minor ailments. I have one in which I am installing modern electrical action. There is a considerable difference in the method of producing sound in the two types of organs. The reed organ embodies the same principle as the harmonica. The sound-producing unit is a brass or bronze tongue which vibrates when air is drawn through the narrow space between it and the brass frame to which it is attached. The pipe organ works on the principle of a whistle. The air is blown through a narrow opening (mouth) at the foot of the pipe, and against the upper edge (lip) of the opening, thus producing vibration of the air column in the body of the pipe. A little investigation behind the back of a reed organ will reveal what makes it "tick". Don't let it scare you. One fact that is not generally known is that a reed organ works on a vacuum rather on a pressure principle as the pipe organ does. The reservoir of the former is exhausted of air by a foot bellows or blower, which action draws air in through the reeds while the reservoir of the latter is filled with air under pressure which, in turn, blows out through the pipes.—D.W. L., Westbrook, Me.

Gus Gets a Fan Letter From Far-Off India

AS A regular reader of POPULAR SCIENCE MONTHLY, I ask leave to draw your attention to the following. I am very much interested in your magazine, particularly in the articles on electricity and radio practice. I like to read articles which tell how to make simple electrical apparatus, such as the electric door chime and transformers. I wish you would write about radio troubles in the form of dialogue just as Gus Wilson talks about motor mechanics. Gus and his Model Garage are very popular among our friends here.—R.N., Bhavnagar, India.

He's a Persistent Bird; You'd Better Let Him In

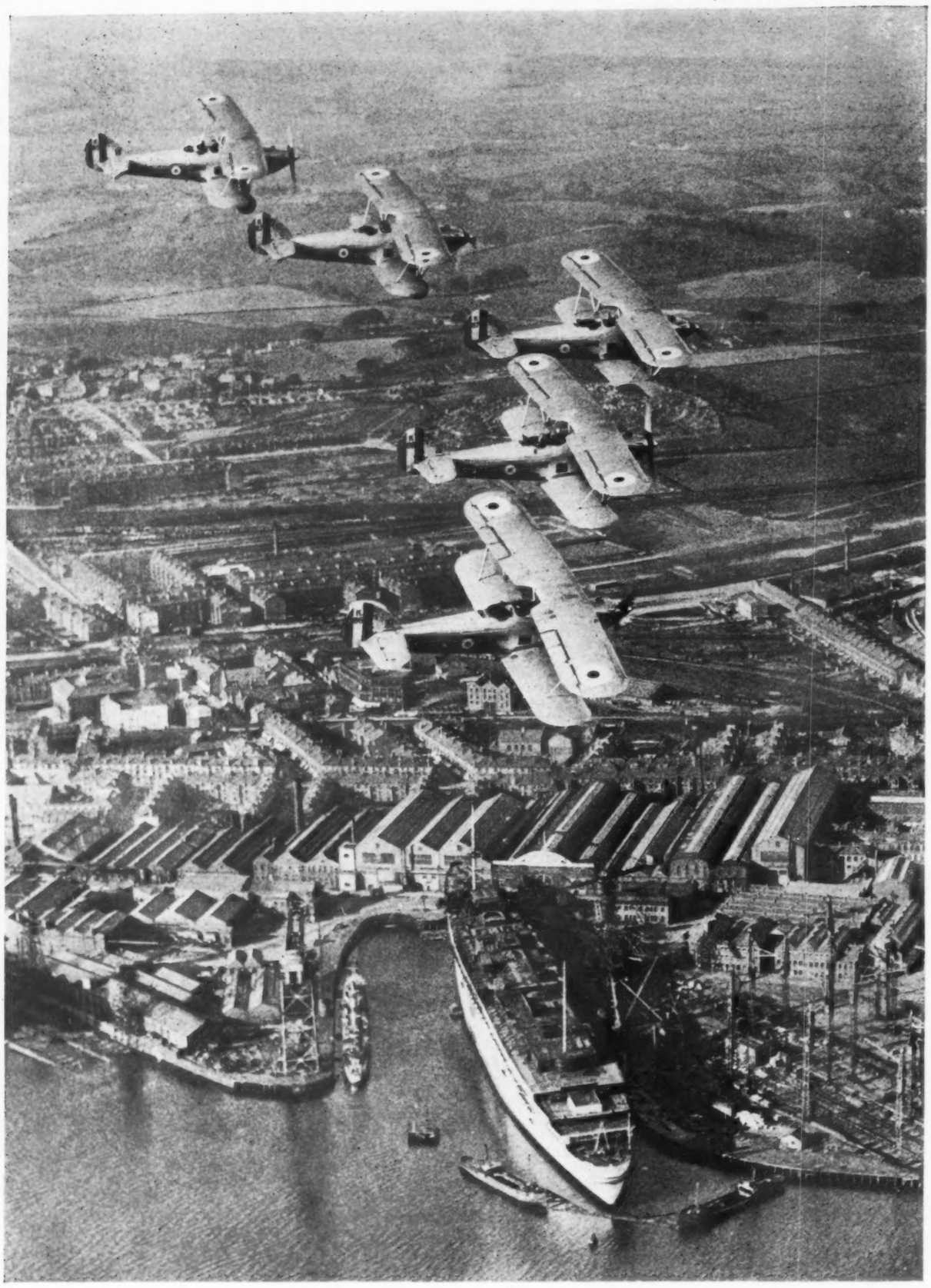
FOR more than a month now a shadow-boxing robin has been trying to peck his way through the ground-floor windows of our house. As regular as clockwork, he arrives at seven every morning and begins a series of power dives that end in headlong crashes into the window pane. This keeps up until dark. Closing the shutters does little good. He merely goes to another window or transfers his attack to the cross-slats of the shutters. Will some bird-loving reader tell me what this redbreast is trying to do? It's a question of which will give out first, the robin's head or my windows.—W.W., Montclair, N. J.

Says One Skipper to Another, Here's How and Happy Sailin'

I READ C.E.E.'s questions about sailboats in a recent issue and, being the skipper of a star classer, I am eager to help him. Here are my answers to his questions: 1. The best running lights for a snipe-class boat are those obtained by using a two-color flash light which is attached to the mast by a patented clip. 2. A Genoa jib is an overgrown jib which reaches from the head of the mast and overlaps the mainsail about one quarter of the way. 3. The best telltale is a piece of baby bunting fastened to the head of the mast. 4. A block and tackle is the only method to relieve pull on the main or any other sheet. 5. Marine paints can be mixed at home. 6. If you intend to mix your own paint, the first thing is to decide on the kind of bottom you want. Then consult a good painter. After the bottom, the sides come easily. Happy sailin'!—R.E., Macatawa, Mich.

He Gets Chased Outdoors But Asks for More Reading

I NOTICE that a letter appears occasionally in Our Readers Say column complaining about the absence of articles on certain subjects. I have a complaint to make but I believe it is an unusual one. My complaint is that your magazine keeps me in the house too much. I do not dislike remaining indoors. The thing that I dislike is the moment — and these moments are increasing in frequency — when I am expelled bodily. Nevertheless, I am willing to endure the fate of a martyr.—E.V., New York City.



A FUTURE QUEEN OF THE SEAS

This is how Britain's new wonder liner, the Queen Mary, *looked to a squadron of bombing planes that flew recently over Clydebank, Scotland, where the ship is being completed*

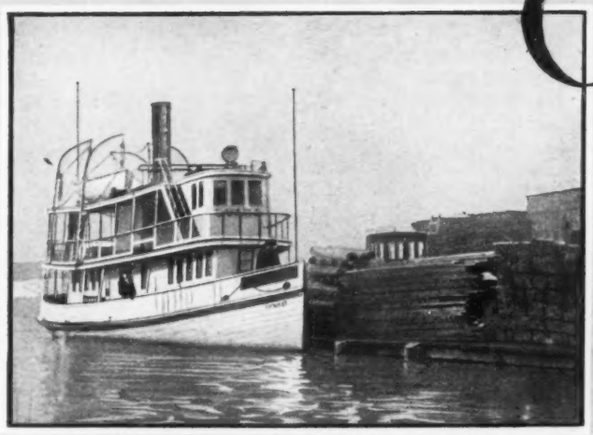
POPULAR SCIENCE Monthly

AUGUST 1935 VOL. 127 No. 2

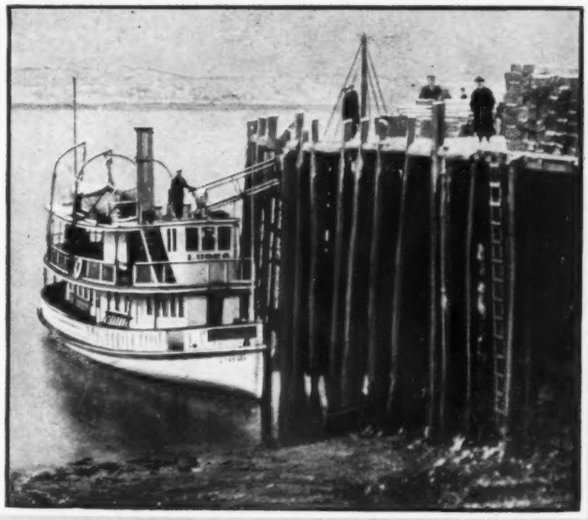
RAYMOND J. BROWN, *Editor*

• NEW GOVERNMENT PROJECT TO REALIZE AGE-OLD DREAM

Electricity from Ocean Tides



The giant tide of Passamaquoddy Bay, at the northeastern tip of Maine, is vividly illustrated in these two photographs taken at Eastport only a few hours apart



The range of the tide at Eastport is sometimes as much as twenty-eight feet. This is the force that Uncle Sam will harness to generators in the newest power project

A FEW weeks ago, President Roosevelt announced his approval of the $36,000,000 project for harnessing the tides of Passamaquoddy Bay, in Maine.

In less than three years, an age-old dream will become a reality. Generators, with a capacity of 200,000 horsepower, will spin in the grip of the world's highest tide, furnishing electric current for homes, farms, and factories, tapping the vast, inexhaustible power of the sea.

Almost exactly half way between the equator and the north pole, where the coast line of Maine juts farthest to the east, the work is already beginning. Under the direction of Major Philip B. Fleming, U. S. Army engineer, 14,000 men will rear great barricades of earth, armored with rock, across the mouths of Cobscook Bay. They will pour in 15,000,000 cubic yards of earth, 6,000,000 cubic yards of rock and 700,000 cubic yards of concrete to form the five huge dams of the project.

Planted on a solid bottom of shale and clay, these barriers will range from thirty-five to 150 feet in height and will have a total length of 14,000 feet. A navigation lock will admit ships to the inner basin and massive, vertical-lift sluice gates will discharge half a million cubic feet of water a second when the ebbing tide drains the inner area. Power will be produced only on the incoming tide.

As this water surges into the Bay of Fundy and reaches Passamaquoddy Bay, its level will rise rapidly above that in the Cobscook basin. When there is a five-foot difference, draft tubes leading to the generators will be opened. Sea water, roaring down them, will spin the great turbines and pour out into the basin beyond. This area is nearly twice that of Manhattan Island. The water, pouring through the draft tubes while the

By
Edwin Teale

A tide-predicting machine evolved by the U. S. Coast and Geodetic Survey. Its complicated mechanism of cogs and pulleys, dials and gauges, saves complicated calculations. It is the only machine of its kind

tides are reaching their peak of from eighteen to twenty-three feet and subsiding again to the five-foot point, will raise the water level in the basin two or two and a half feet. When the difference between the level of Passamaquoddy Bay and the basin is less than five feet, the generators will be shut down. Efficiency with less than a five-foot head is too small for practical operation.

At low tide, the sluice gates will rise and the excess water in the basin will rush back into the sea. Thus, for two seven-hour periods a day, the generators will be humming; for two five-hour periods, they will be silent.

These times of work and inactivity will vary from day to day. As the reader knows, the tide is produced by the gravitational pull of the moon. As the moon passes its zenith approximately fifty minutes later each night than on the preceding night, the ebb and flow of the tide varies accordingly. This fact has been the stumbling-block in the past to large scale tide-power projects.

Unless a hydroelectric plant can produce current when it is needed most, it is of little value. And with high tide and the peaks of production varying from day to day, the demand for current might come when the generators were shut down, and the plant might be running full-blast when the demand was almost nil. Some method of storing up excess power is vital to the scheme.

To accomplish this, an ingeniously simple plan will be put in operation at Passamaquoddy Bay. High-tension lines will carry excess electricity during peak production to a huge pumping station at Haycock Harbor, fifteen miles away. Here, pumps that are rated at 180,000 horsepower will force water from the ocean into a 13,000-acre reservoir, 130 feet above the level of the sea. When the tide-power generators are inactive and current is needed, this water will be permitted to rush back to the ocean through penstocks, whirling turbines and producing electricity. Through this simple procedure, electric power will be stored up as water power and turned back into electric power at will.

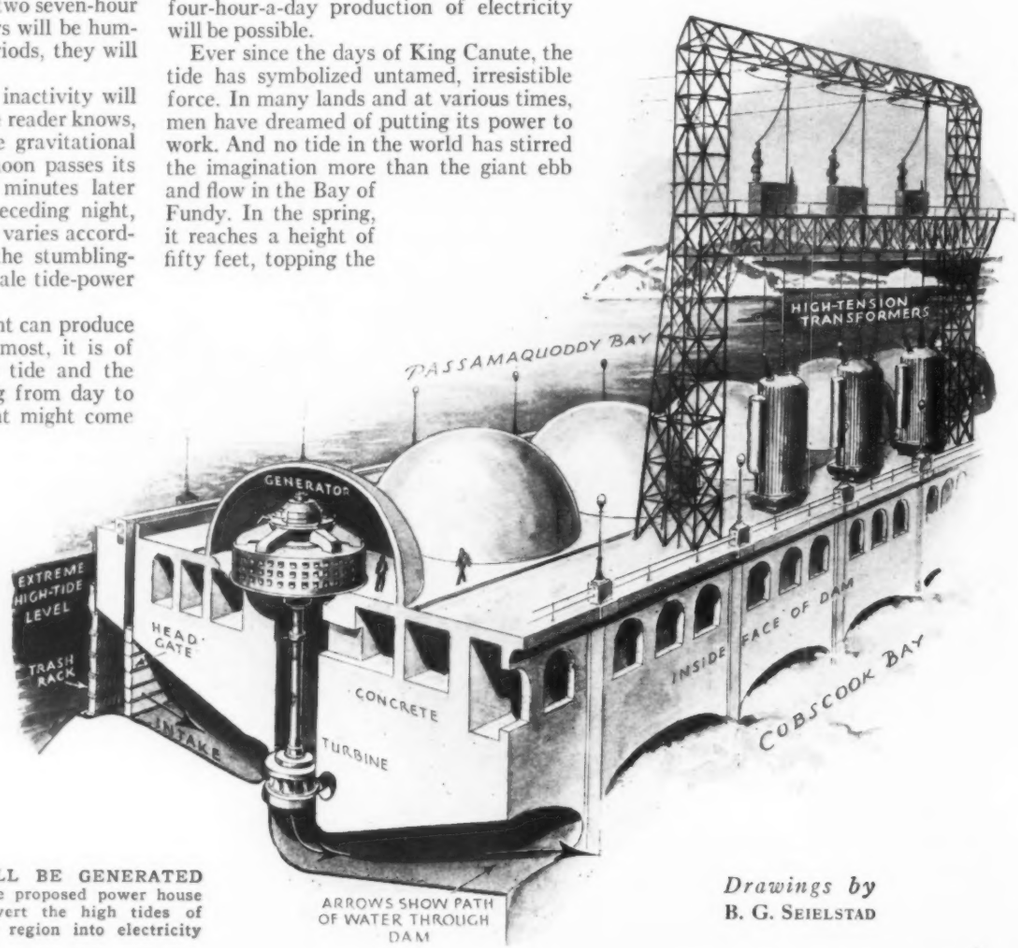
Eventually, this reservoir may not be needed. The present development lies entirely within American territory. Later, it may be expanded into an international project, damming off the upper end of Passamaquoddy Bay, which lies in Canadian waters, to form a second basin with an area of nearly 100 square miles. It would be filled at high tide, the difference between its water level and that of Cobscook Bay permitting the steady production of current. With this upper pool filled at each high tide, and the lower pool emptied at each low tide, regular, twenty-four-hour-a-day production of electricity will be possible.

Ever since the days of King Canute, the tide has symbolized untamed, irresistible force. In many lands and at various times, men have dreamed of putting its power to work. And no tide in the world has stirred the imagination more than the giant ebb and flow in the Bay of Fundy. In the spring, it reaches a height of fifty feet, topping the famous tide of Port Gallegos, Argentina, by nearly fourteen feet.

Even stranger is a fantastic waterfall which cascades upstream in the St. John River. A few miles above the Bay of Fundy, the St. John passes through a narrow, rocky gorge. Beyond, the river bed widens into a natural basin. When the incoming Fundy tide rolls up the river, the volume of water is too great to pass through the gorge. It piles up on the downstream side, rising higher and higher until it forms a waterfall that flows upstream until the tide turns. Then the reverse happens. The water in the basin above the gorge piles up and produces a waterfall dropping in the downstream direction. For six hours, this waterfall made by the tides flows upstream and for six hours downstream. Frequently, it reaches a height of twelve feet.

IN measuring the tides, the U. S. Coast and Geodetic Survey employs automatic gauges. A float, rising and falling in a cylinder, moves a pencil along a graph sheet revolved by clockwork to record the ups and downs of the tide. For the delicate work of predicting the tides, the scientists have devised an involved "mechanical brain"—an immense mechanism of cogs and pulleys, dials and gauges. It is the only one of its kind in the world.

The records of the Washington experts show that the height of the tide varies widely at different points along the same coast. At Boston Harbor, for instance, the height of the tide is about ten feet. Less

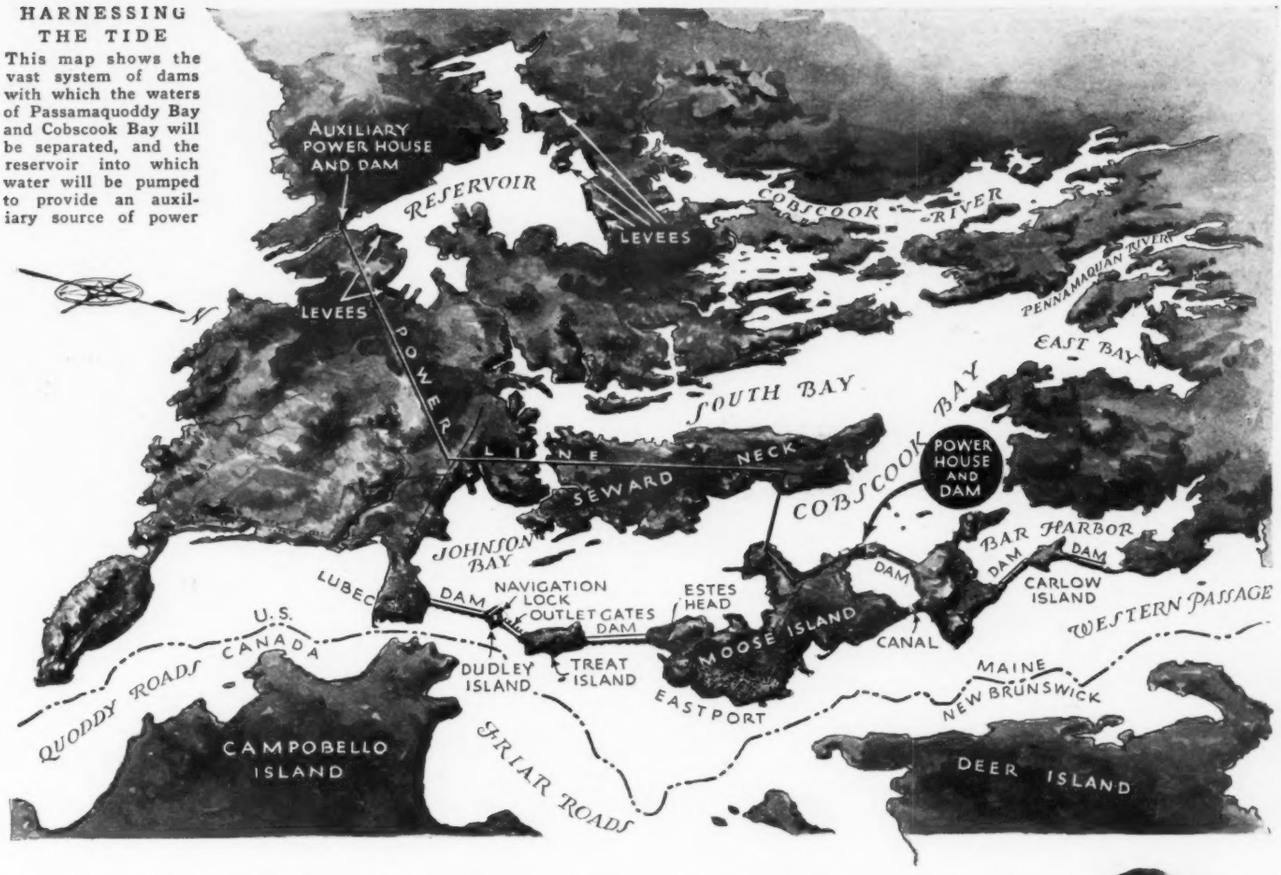


WHERE POWER WILL BE GENERATED
Schematic drawing of the proposed power house and dam that will convert the high tides of the Passamaquoddy Bay region into electricity

Drawings by
B. G. SEIELSTAD

HARNESSING THE TIDE

This map shows the vast system of dams with which the waters of Passamaquoddy Bay and Cobscook Bay will be separated, and the reservoir into which water will be pumped to provide an auxiliary source of power



than 100 miles to the south, at Nantucket Island, it is hardly more than one foot, while 400 miles to the north, in the Bay of Fundy, it is the greatest known, fifty feet.

The man responsible for the plan to harness the giant Fundy tides at Passamaquoddy Bay is Dexter P. Cooper, a civilian hydroelectric engineer. He will be associated with Major Fleming in carrying the idea to completion. In a Washington, D. C., club, the other day, Cooper told me the fascinating story which lies behind the project.

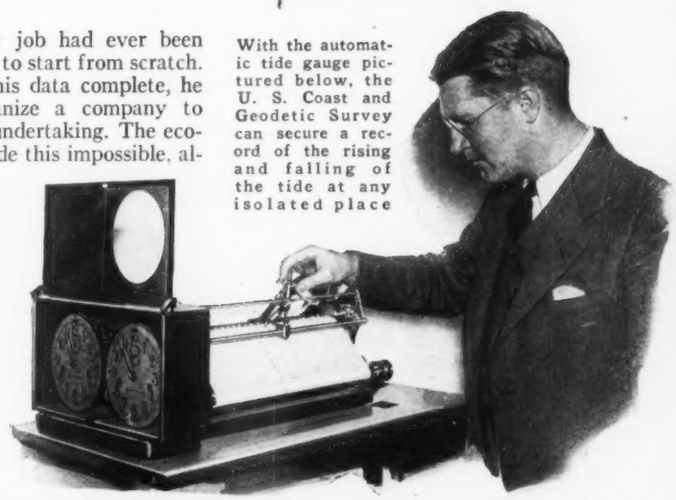
In 1919, on his return from installing a hydroelectric plant in the Andes Mountains of South America, he was taken ill. During his convalescence, he spent several weeks on Campobello Island, in Passamaquoddy Bay. With nothing to do, Cooper spent whole days watching the tides swirl past the island. He calculated the billions of horsepower going to waste. As a sort of hobby, he began imagining ways of putting the rising and falling water to work. In the end, he became convinced of the entire practicability of harnessing the Fundy tides.

With his brother, Col. Hugh L. Cooper, the man who directed the work at Muscle Shoals in Alabama and who built the great Dnieperstroy hydroelectric plant in Russia, he had carried out engineering projects in various parts of the world. As a trained engineer, he began assembling his data.

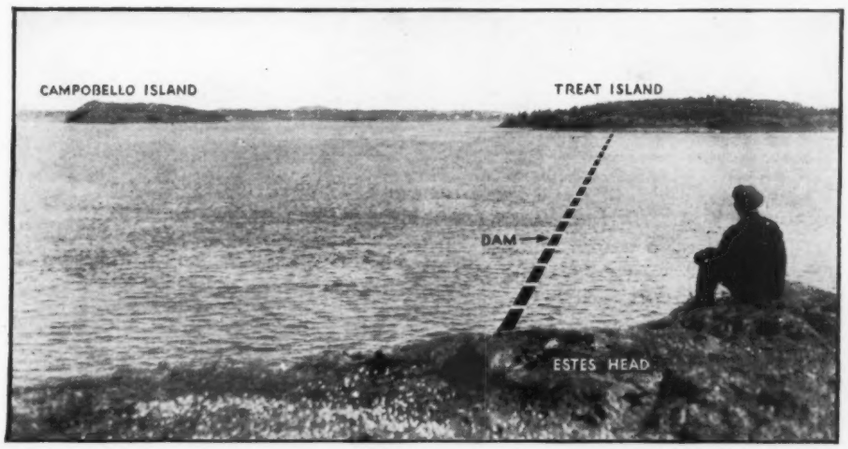
For five years, he worked with a staff of helpers. He took diamond-drill borings. He surveyed the shore line for 400 miles. He set up a laboratory at Eastport, Me., the headquarters of the present project, and there built and tested miniature dams and gates and locks. Delicately regulated pumps subjected these models to water stresses exactly proportional to those of real dams.

No large tide-power job had ever been done and Cooper had to start from scratch.

When he had all his data complete, he started out to organize a company to finance the gigantic undertaking. The economic depression made this impossible, although a commission appointed by the Governor of Maine reported enthusiastically on the proposition. Now, by a quirk of fate, another man who also had watched the tides from the shore of Campobello *(Continued on page 92)*



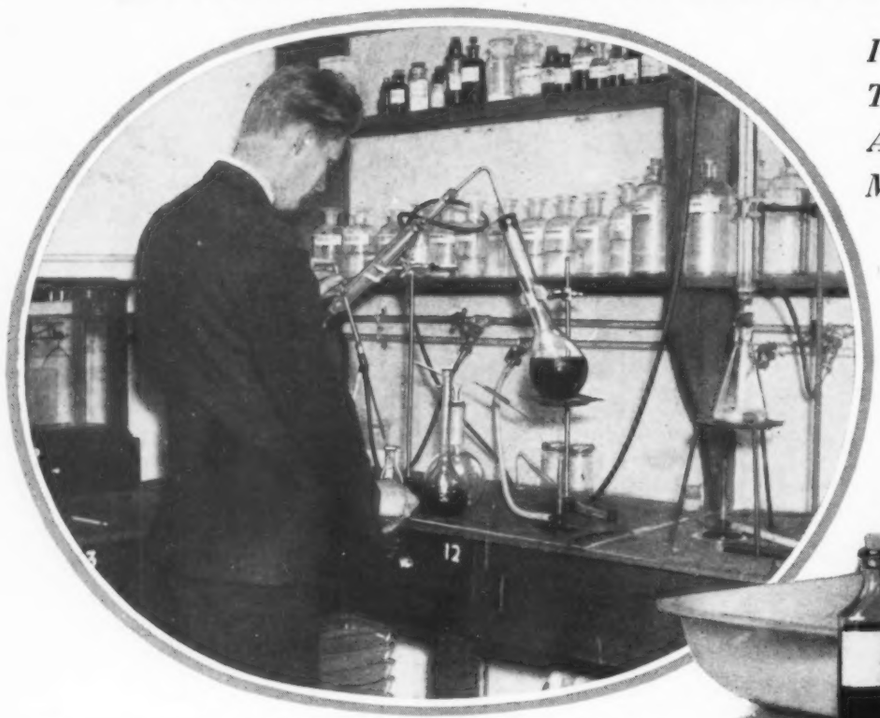
With the automatic tide gauge pictured below, the U. S. Coast and Geodetic Survey can secure a record of the rising and falling of the tide at any isolated place



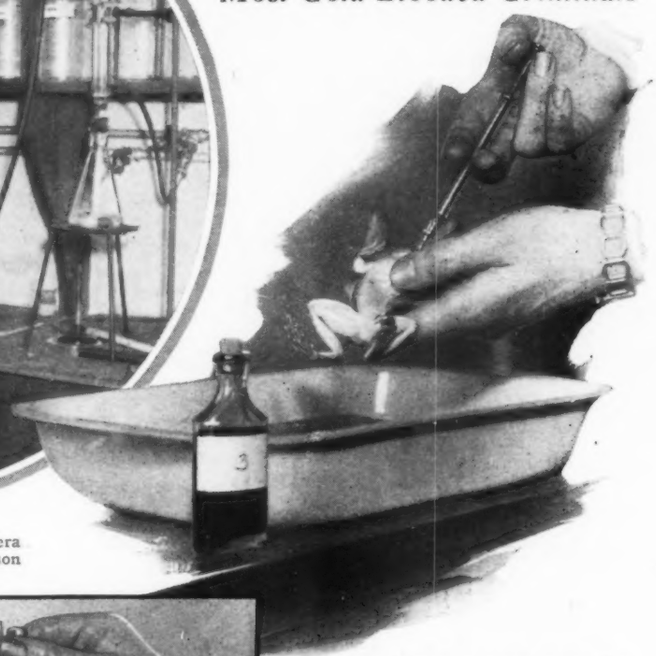
The dotted line indicates the future location of one of the dams of the Passamaquoddy project, stretching between Estes Head on Moose Island, and Treat Island, which is seen in the distance

Poison Murders Solved

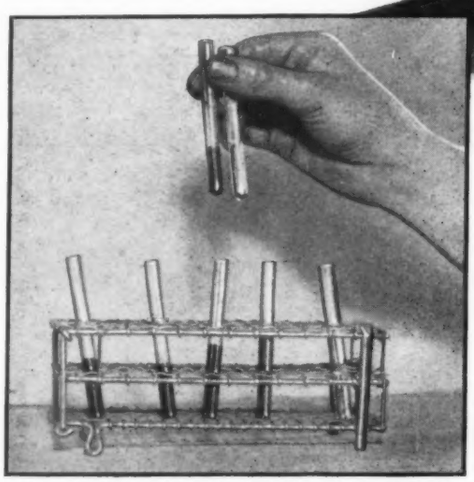
In Delicate Analytical Tests, The Chemist Pits His Skill Against the Cunning of the Most Cold-Blooded Criminals



The colored liquid in the flask contains macerated portions of the viscera of a suspected poison victim. It is being distilled for tests to detect poison



An experimenter injecting poison into the lymphatic gland of a frog to observe its effect on the action of the heart



The precipitin test to identify blood as animal or human. Prepared serums, taken from rabbits immunized against human blood, are used

By WILLIAM WOLF

TWO MEN were sentenced to death early this year in India for a murder in which plague germs were rubbed into a pin-prick on the victim. Described as an "unparalleled example of diabolical ingenuity" at the trial, the murder method added another means of poisoning to the already long list crime investigators encounter.

Fascinating because they usually are committed with a cold precision not common to other slayings, poison murders offer to the new type of scientific detective ideal cases in which to employ analytical methods. With few exceptions, such murders are solved in the laboratory with a skill that is uncanny to the layman.

"Forensic analysis" sounds harmless enough, but it is the science of toxicology brought to a high state of development at the Philadelphia College of Pharmacy and Science. Through it, the cunning of the poisoner is pitted against the skill of the analytical chemist and the murderer stands a poor chance of winning.

The clever devices employed in slaying with drugs and chemicals reveal that poisoning often is a deadly art. Unlike slaying with the knife or gun, poisoning offers a wide choice of vehicles in which to convey the death-dealing agent. The poisoner, in addition, is almost invariably of a higher mental type than the gunman or thug. For that reason, America can expect an increase in the number of poison murders, since a nation's homicidal deaths from drugs increase with the country's advances in refinement and culture.

Chewing gum, sleeping powders, candy, food, wine, beer and whisky, finger rings with syringes attached, specially constructed knives, medicines of all kinds—practically everything in everyday use has been employed for administering poison to a chosen victim.

It is the task of the scientific investigator to learn, first, if a death has been caused by a poison and, if so, to determine what poison was used and how it was administered.

Both results are achieved by analytical chemistry. The Philadelphia College crime investigator subjects portions of the victim's viscera, flesh, or brain tissue to a methodical process of chemical tests in which one type of poison after the other is sought. When the type is identified, the actual poison can be isolated. The same process is followed in the examination of the food, candy, or whatever is suspected of containing the poison.

The "poison-kiss" murder some years ago in Cumberland, Md., is an excellent example of how easily poison, once suspected, can be detected. In this amazing case, a young man and his fiancee were found seated on a sofa at her home, rigid in death, the morning before their wedding. The faces of both were flushed, and the man had suffered a slight oral hemorrhage. The external evidence, which often sets the chemical analyist on the right track at once, indicated cyanide of potassium.

In the man's mouth was found a piece of chewing gum and the remainder of the pack was discovered later at his home. A chemical analysis of the gum and stomach contents of both victims revealed the suspected potassium cyanide as the fatal agent. Tests for other poisons were made. None was found, and the case was closed from the toxicologist's viewpoint. Legally,

by Test-Tube Sleuths

the courts decided that the man had intended to kill only the woman but had underestimated the deadliness of cyanide and had swallowed some as he kissed her to convey the poison.

Such is the side of a story that the public knows. Behind it is the seldom-mentioned laboratory work wherein the finger of science points unerringly to the active poison.

When a sample is brought to the Philadelphia College for investigation, it goes through a process that reveals the value of the toxicologist's testimony before a court. Nothing is left to chance. If a portion of viscera is submitted for analysis, the toxicologist keeps detailed notes of its receipt —where it was obtained, what it is, the time it was delivered, its condition and its weight. All this careful preliminary work is necessary if evidence is to be given in a trial. Defense lawyers are always alert for any loophole in such testimony.

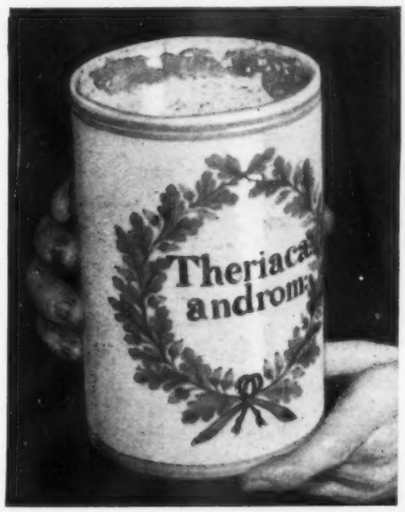
The sample is divided into three portions. One is for reference should anything happen to the others, another is for qualitative tests to determine what kind of poison was used, and the third is for quantitative tests to learn the amount of the poison.

One sample is chopped into fine pieces. Arsenic, the poisoner's old favorite and stand-by for centuries, is sought first—not because it is the most common of poisons, but because the Reinsch test for arsenic, bismuth, antimony, and mercury can be readily applied. A piece of prepared copper will become stained by any of these poisons if it is boiled in a liquid with them. Each poison can be identified by a distinguishing test of the exposed copper.

A typical case of arsenical poisoning, which fortunately had no fatal results but in which the poison was detected by similar methods, occurred in 1934 near Philadelphia. A woman was charged with trying to poison her brother by sending him a box of fudge. The candy was dosed with arsenic, and six persons became ill after they ate it. The candy was analyzed and the poison detected. The woman was traced through the typed address on the package, and a fingerprint.

The next step in the analysis of a sample is to look for volatile poisons, or those capable of being detected through distillation. The chopped-up sample, with liquid added, is heated in a flask. The vapors are condensed and the resulting fluid subjected to many tests. In the volatile group fall chloroform, ethers, alcohols, phenol, phosphorus, and most of the alkaloids. Tests are made for the non-volatile poisons, such as strychnine, luminal, and veronal, after the distillation. Finally, the metallic poisons are sought by destroying all organic matter through heat and leaving any possible metals in solution.

A SUPPOSED MASTER ANTIDOTE
Theriaca Andromachi, a mixture of more than fifty ingredients, was long considered to be an antidote against all known poisons



Inaccurate reports occasionally appear in the newspapers about some deadly poison that leaves no trace. Such stories are misleading, for the tests mentioned will reveal the presence of any chemical poison. There is only one recorded case in which a poison defied detection and this was due to no fault of the toxicologists.

A young German scientist, Dr. Joseph Born, visited England in 1925 in an effort to sell a method for making synthetic alkaloids, such as atropine, cocaine, and nicotine, which would reduce their costs. His money ran short, no one seemed interested, and finally he took his own life. He left a note reading: "I must die by my own invention. Is it not funny?"

Qualitative tests such as those discussed should have shown what poison Dr. Born used. They didn't. Apparently he had invented the synthetic drugs and they left no traces when he used them, ironically, to take his own life.

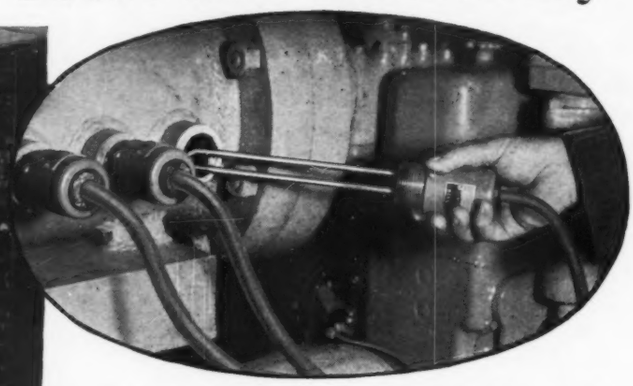
Obviously, where poison is not suspected, the poisoner has an excellent chance to escape. For that reason, the present practice is to have the man who will make the chemical analysis present at the autopsy in all suspicious deaths. There are many things about the victim's body that will indicate poisoning to him and often he is furnished with a clew that aids him in his analysis.

The arrow poison of South America, curare, is much favored by mystery-story writers as a toxic substance which is supposed to be quite baffling. But it would not deceive a Philadelphia College investigator. Curare falls into the alkaloid group and the investigator knows its action through experiments. Frogs, if injected with curare, *(Continued on page 94)*

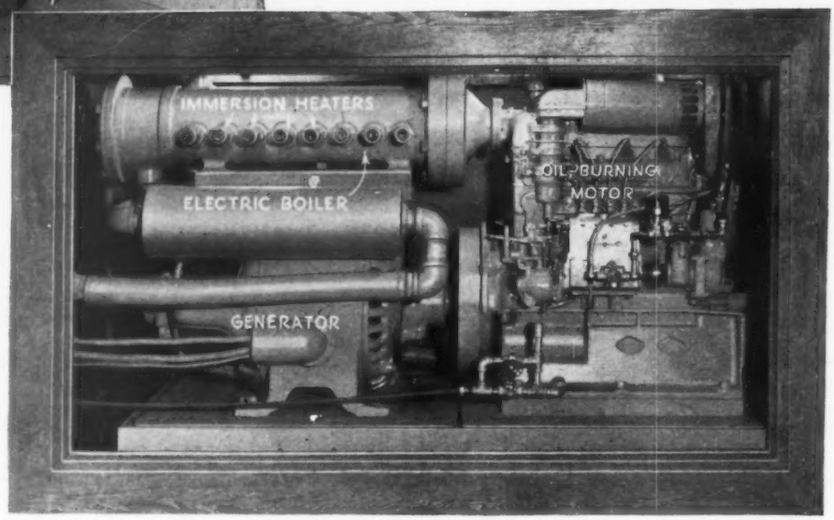
Below, an investigator is scraping from a brick wall some stains believed to be blood. A sterile knife is used, and care is taken to get as little brick as possible. The brick is tested separately

An operator weighing isolated poisons. In the foreground, the Gutzeit test

Home Plant Supplies Heat and Electricity



Immersion-type heaters like this operate the heating system of the house. Below, a side view of the unit, showing working parts



This compact unit, which occupies less space than the hot-water heating system formerly used in the inventor's home, supplies all the heat, light, and power required in the household at far less than the previous cost

BY COMBINING a home generating plant and a house-heating installation, in a single compact cabinet no larger than a piano crate, a Greenwich, Conn., inventor provides a new departure in household engineering. The "vest-pocket" power plant dispenses with the need for any outside electric supply. It generates sufficient current to light the owner's lamps, run his appliances, cook his meals, and even heat his home—and does this so economically, the inventor says, as to effect substantial savings in his total yearly bill for fuel and power.

One of the midget power plants unobtrusively occupies a corner of the basement in the inventor's home, where he has tested it in actual operation. Removing a front panel reveals the source of power—an internal-combustion motor not unlike that of an automobile in general appearance, but technically of radical design. It runs on cheap fuel oil of the grade commonly sold for house heating, thus accounting for much of the miniature plant's economy. The motor spins a husky electric generator, producing current for household use.

The self-contained unit is more than a power plant. A part of the electricity from the generator is led through a row of immersion-type electric heaters, in a miniature boiler within the same cabinet. The boiler supplies steam or hot water, according to the character of the installation, to the heating system of the house. When the temperature of the house rises above a predetermined point, a thermostat actuates relays that progressively cut off one or more of the immersion heater units, and a governor on the oil engine simultaneously shuts down to hold it at constant speed.

In an ordinary internal-combustion engine, the heat that must be absorbed by the water in the cooling system, to keep the cylinders and pistons from becoming red-hot and sticking, represents a waste of fuel. So does the heat in the gases blown out the exhaust. The new system recovers nearly all of this waste heat, using the heated water from the cooling system, and from a water jacket placed around the exhaust, to supplement the output of the electric boiler.

Automatic controls on a panel near the power cabinet distribute current as required for heating and for other domestic needs. The ample surplus of electricity available makes electrical cooking economical. According to the inventor, the cost of current from this power plant is far less than if it were purchased.

To suppress sound and vibration, the inventor has enclosed the machinery in a cabinet of soundproof material and mounted the whole unit upon a platform that "floats" on two inflated automobile tires.

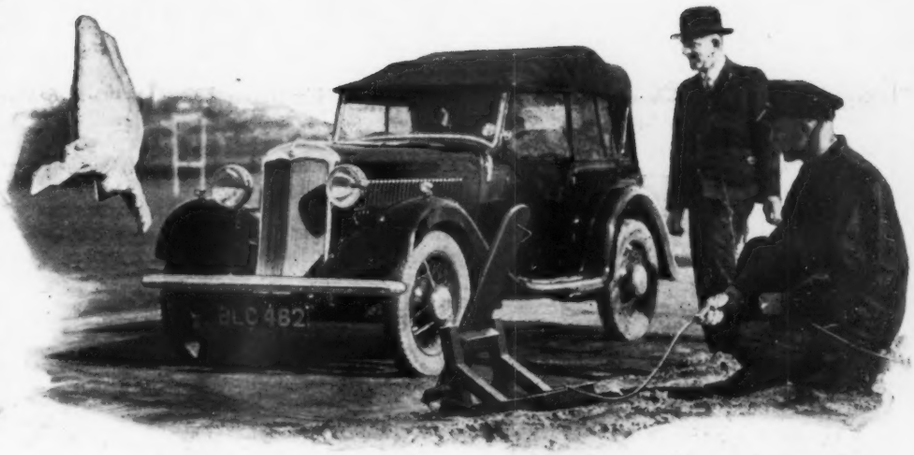
TEST POWERED PLANE IN WIND TUNNEL

Airplane model, powered with a twelve-horsepower electric motor, mounted in a wind tunnel for tests to obtain data on propellers

TO OBTAIN data on three-bladed propellers, California Institute of Technology experimenters recently undertook what are believed to be the first wind-tunnel tests ever made of a powered airplane model. A twelve-horsepower electric motor spins the propeller of the miniature plane at 12,000 revolutions a minute, producing a drone that can be heard a block away, while scientists observe the propeller wash and its effect on stability. Despite this propulsive force, the model is held firmly captive by wires and balance weights.

CATAPULTED DUMMY TESTS DRIVER'S SKILL

So THAT the driver of a radio car will know what to do if someone darts across a street in front of his speeding machine, instructors of a police school at Hendon, England, have devised an ingenious training method. The student is required to drive along a test course, and at some unannounced point a concealed catapult hurls a stuffed dummy in front of the car. Observers rate the driver on his ability to stop or swerve in time to avoid hitting the supposed pedestrian. The catapult is operated by a spring, and a jerk on a rope releases its trigger. All drivers of London's police cars receive this training.



This machine throws a dummy unexpectedly in front of a moving car to test the driver's skill

User finds message left for him on machine

SLOT MACHINE IS MESSAGE HOLDER

MAKING or canceling engagements is easy for the user of a device known as the "Notificator," developed in England for use in railway stations and stores and at large public gatherings. By stepping upon a small platform and dropping a coin in a slot, the patron exposes a slowly moving paper roll on which he may write a message to a friend. The message remains in view for two hours. Several rolls are provided on the machine, so that a large number of messages can be accommodated. Such messages include explanations for unkept appointments.

Photo at left shows how shirt grip is worn. Below, the grip detached

GRIPS KEEP SHIRT FROM SLIPPING

To KEEP shirt and trousers from parting company, a novel dress accessory has been introduced, consisting of a pair of live-rubber strips worn within the waistband of the trousers at the sides. The spongy inner surface of the rubber is said to grip the shirt securely, preventing it from working up, and also to keep the trousers from sagging. The strips are invisible while being worn.

AMBULANCE SQUAD USES NOVEL RESCUE EQUIPMENT

Rescue squad demonstrates a portable hoist used to lift injured workers from manholes

ESPECIALLY equipped to cope with unusual industrial accidents, an ultra-modern ambulance station has been established at Plymouth, England. Its apparatus includes a long-handled pair of tongs, wielded by an asbestos-clad rescuer, to drag persons from a blazing car or plane; a portable hoist for lifting an injured person from a manhole; and a full complement of first-aid equipment.

Asbestos suit and long-handled tongs designed for dragging persons from burning autos

ELECTRIC EYE CHECKS VITAMINS IN MILK

INCORPORATED in a new meter, an electric eye now measures the potency of ultra-violet rays used to increase the vitamin content of milk. Thus it enables the production of vitamins to be measured at a glance, as above, instead of by time-consuming tests upon animals as heretofore. Engineers state it affords a check of the vitamin potency of irradiated milk as accurate as that of pasteurization.

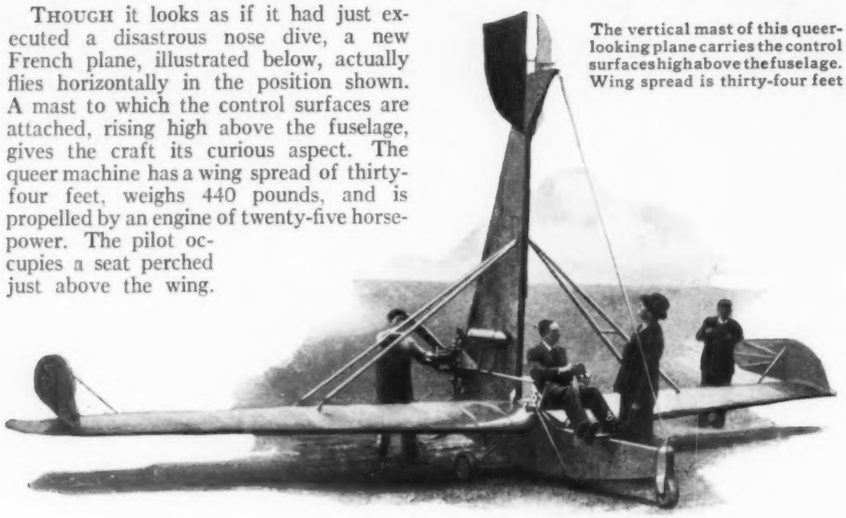
SAME HANDLE FITS BOTH HUNTING KNIFE AND AX

DESIGNED for sportsmen and campers, a new combination tool includes a camp ax and a hunting knife, with an interchangeable handle which can be attached rigidly to either by means of a spring lever. The kit is carried in a leather case.

Ax and hunting knife with interchangeable handle

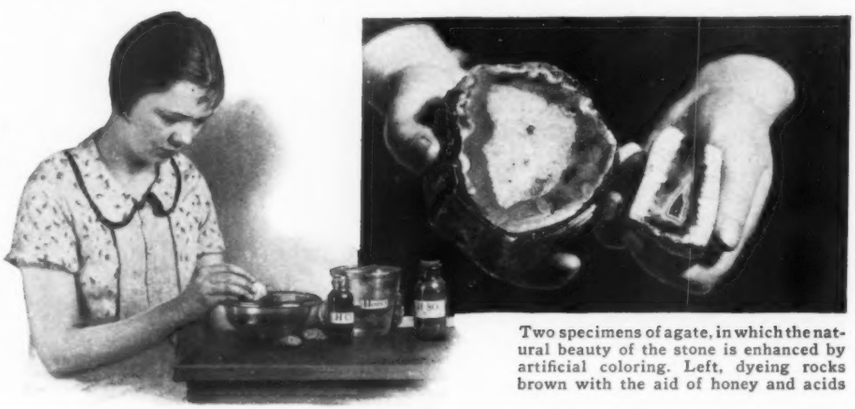
QUEER AIRPLANE HAS VERTICAL MAST

THOUGH it looks as if it had just executed a disastrous nose dive, a new French plane, illustrated below, actually flies horizontally in the position shown. A mast to which the control surfaces are attached, rising high above the fuselage, gives the craft its curious aspect. The queer machine has a wing spread of thirty-four feet, weighs 440 pounds, and is propelled by an engine of twenty-five horsepower. The pilot occupies a seat perched just above the wing.



The vertical mast of this queer-looking plane carries the control surfaces high above the fuselage. Wing spread is thirty-four feet

DYEING ROCKS IS STRANGE NEW HOBBY



Two specimens of agate, in which the natural beauty of the stone is enhanced by artificial coloring. Left, dyeing rocks brown with the aid of honey and acids

IMPROVING on nature by dyeing rocks in artificial colors is a new fad imported from abroad. Agates and some types of quartz provide suitable material. An agate may be colored by soaking in a solution of sugar or honey, which is drawn into the stone by capillary attraction, and then in sulphuric acid. The acid chars the sugar in the porous layers of stone, producing brown shades, and the contrasting rings of colored and uncolored stone give a striking effect. Hydrochloric acid gives a lemon-yellow color. Soaking in ferrous sulphate, and then heating, gives reddish tints, ferric oxide being formed. Other effects are possible with chromium and nickel solutions and with organic dyes. Heat alone changes the color of many stones, turning smoky quartz to an amber hue, and greenish-colored beryl to blue.

Housewives who have no washing equipment at home do their laundry at this self-service establishment

DO THEIR OWN WASH IN SELF-SERVICE LAUNDRY

A SELF-SERVICE laundry just established at Fort Worth, Tex., enables housewives who have no washing machines at home to bring in the family wash and enjoy their convenience. A nominal fee is charged for the use of a washer, current, soap, and water. So far the proprietor has installed twelve electrical washers, and he declares his unusual enterprise a growing and profitable one. Individual stalls, each containing a complete outfit, are provided.

DISK TO PLAY SIX WEEKS

EXPERTS predict a phonograph record capable of playing continuously for 1,000 hours as a development of the near future. The user could play his phonograph day and night for more than forty-one days without changing a record.

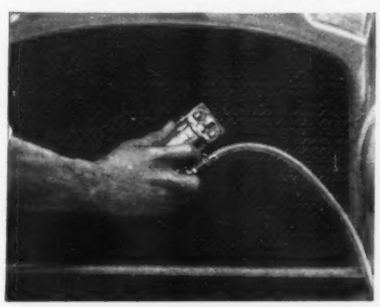
CAPTIVE 'CHUTE PERMITS 100-FOOT LEAP

Captive parachute in use. Guide cables control descent

SEATED in a captive parachute, a novice may drop from the top of a 100-foot tower at Prospertown, N. J., and experience the sensation of a jump with a regulation 'chute in perfect safety. Similar jumping towers have been in use in Russia for training flyers (P.S.M., Mar., '35, p. 18), but from these the passenger's fall is regulated by cables and counterweights. The American model allows the permanently opened 'chute to fall freely, air alone checking its descent, until within a few feet of the ground. Vertical guide cables prevent a gust of wind from sweeping the 'chute and its passenger against the steel tower, and provide an automatic brake at the moment of landing. The new captive parachute is expected to have application not only as a training device, but also as a thriller attraction for amusement parks. The photograph shows Amelia Earhart, famous woman flyer, trying out the device during a recent demonstration.

DIAL POCKET DEVICE TO GET WEATHER FORECAST

EVERY man may be his own weather forecaster with the aid of a pocket device just introduced. A dial showing graduated tints is first turned to match an indicator, the color of which changes with the humidity. A second adjustment is made for wind direction, and the weather to be expected within the next fifteen hours is indicated in the dial window.



PNEUMATIC TOOL SHAKES SCALE FROM RADIATOR

SCALE that forms in automobile radiators, obstructing circulation in the cooling system and causing overheating, is readily removed by a new tool. The device resembles an electric vibrator. When it is held against the radiator, as shown above, the vibrations are said to loosen scale without injury to the core or seams. On cars with ornamental radiator guards, such as are found on many current models, the tool may be applied to the rear side of the radiator from inside the hood.

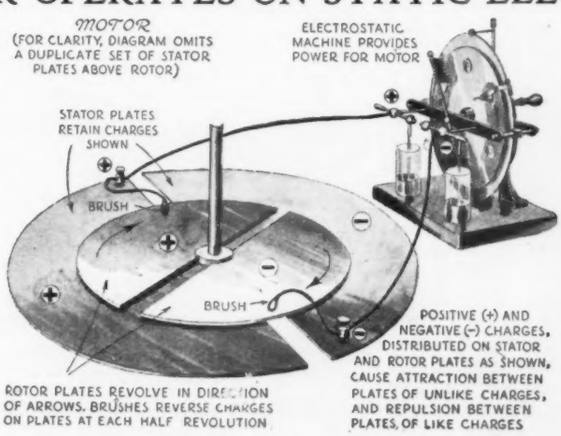
MODEL KIT FEATURES MOLDED UNITS

Premolded parts for a model plane are shown at right. Below, the fuselage assembled and the model as completed

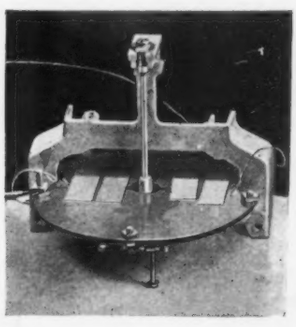
AIRPLANE model-making is simplified by a new style of construction set, providing premolded parts of a lightweight material resembling pressed fiber. Fittings that might tax the skill of the amateur builder are supplied already shaped. All that is necessary is to trim the parts with shears or razor blade and assemble with finishing strips. The material is declared to be practically indestructible and to permit lighter and stronger construction than balsa wood.

NOVEL MOTOR OPERATES ON STATIC ELECTRICITY

A MOTOR that runs on static electricity is an electrical novelty constructed by a Morris, Minn., experimenter. Forces of attraction and repulsion operate as in conventional motors, except that an electrostatic field replaces the usual electromagnetic field. When power is supplied by a static machine of the type found in high-school laboratories, the rotor spins at 200 revolutions a minute. If the motor is connected, instead, to an antenna and the ground, it will run on atmospheric electricity during a storm. The builder suggests that such a motor might find practical application in a meter for measuring static electricity in the atmosphere.

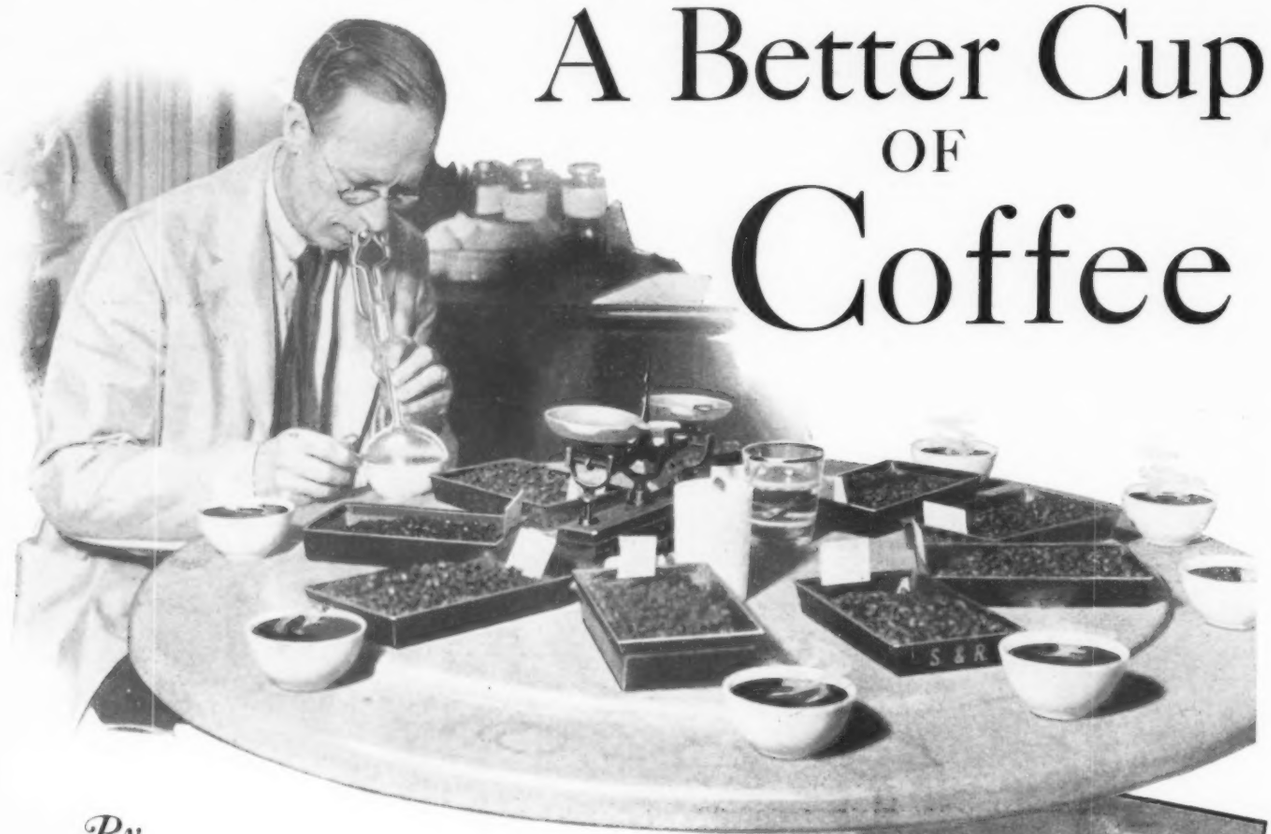

MOTOR
(FOR CLARITY, DIAGRAM OMITS A DUPLICATE SET OF STATOR PLATES ABOVE ROTOR)
ELECTROSTATIC MACHINE PROVIDES POWER FOR MOTOR
STATOR PLATES RETAIN CHARGES SHOWN
BRUSH
BRUSH
ROTOR PLATES REVOLVE IN DIRECTION OF ARROWS. BRUSHES REVERSE CHARGES ON PLATES AT EACH HALF REVOLUTION
POSITIVE (+) AND NEGATIVE (−) CHARGES, DISTRIBUTED ON STATOR AND ROTOR PLATES AS SHOWN, CAUSE ATTRACTION BETWEEN PLATES OF UNLIKE CHARGES, AND REPULSION BETWEEN PLATES OF LIKE CHARGES

The odd motor pictured below runs on static electricity. The diagram at left shows how an electrostatic field provides the motive power



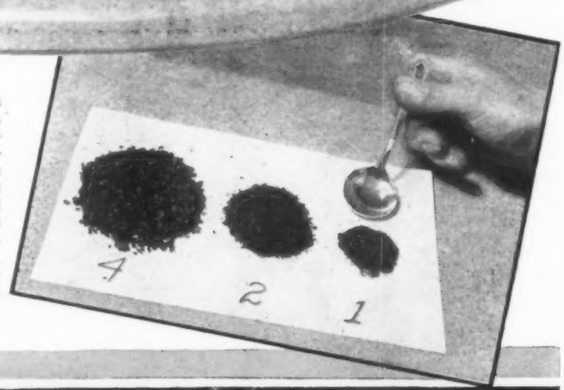
HOW THE LABORATORY GIVES YOU

A Better Cup OF Coffee



By

CHARLES E. PAGE



The author at work in his coffee laboratory. He is using the aromascope, one of his inventions, to study the aroma rising from a cup. The three piles of ground coffee at the right make the same amount of average-strength beverage, the difference being due to the fineness of grind

THE other day, one of my clients stamped up the stairs and swung open my laboratory door. He plumped down two small boxes on the revolving stone table where I arrange cups for testing coffee. Then he told me his troubles.

Some weeks before, he had ordered several thousand dollars worth of green coffee similar to samples coming from a certain plantation in Colombia. The wholesaler had just delivered the first shipment and the buyer suspected that the coffee wasn't the same as the samples. But he couldn't prove it. He wanted me to get busy with my apparatus and see whether he was right or wrong in his suspicions.

I studied the beans with a magnifying glass. Their size, shape, and character convinced me they were Colombian coffee. Then I sliced off thin sections with a razor and slipped them under a high-powered microscope. The cellular construction showed they both came from the same section of the country.

But that was not enough. The delicate aroma and flavor which mark the best coffees vary from district to district and even from plantation to plantation. Subtle differences in soil, water, fertilizer, elevation, and handling determine the character and value of the beans.

So, as a final test, I crushed some of the green coffee in a mortar, added acids to eat away the organic material, and tested the remaining solution for metals. In varying proportions, eight metals have been found in coffee beans. They are iron, copper, nickel, magnesium, manganese, tin, aluminum, and calcium. Drawn from the earth, the metals are deposited in the beans during their growth. Thus, the proportions of the metals in a

Workers on a coffee plantation in Costa Rica spreading the beans to dry in the sunlight.

given bean provides a fairly accurate key to the soil and the spot from which it came.

My tests showed that the buyer was right. The delivered beans contained far more iron than the sample coffee. They could not have come from the same plantation. I went shopping down Coffee Row, as Front Street in New York City is called. When I returned, I brought back half a dozen Colombian coffees. These I tested for metals. The proportions in one batch fitted exactly into the pattern of the original sample; those in another into that of the delivered coffee. Through the dealers I traced them to their sources. Thus, my test tubes not only gave absolute proof of the substitution but traced the inferior beans to the very spot from which they came!

Science is taking the guesswork out of the coffee world.

The instance I have just related is but one of many riddles brought to my New York laboratory. I am a coffee engineer. Hotels, railroads, the state and Federal governments, department stores, a chain of sandwich counters, as well as innumerable buyers and dealers, have brought me their coffee problems for study and solution.

No other country in the world consumes as much coffee as America. In 1933, our importation averaged ninety tons an hour, 3,000 pounds a minute, or fifty pounds a second. The average family uses a pound of coffee every eight days. Last year, we consumed 60,959,760,000 cups of coffee, three cups for every one of tea. In England, the proportion is five cups of tea to one of coffee. Nothing brought from abroad for human consumption or wear equals the value or tonnage of coffee. It has been our depression drink. In 1931, when the depression was getting in some of its hardest licks, coffee consumption reached an all-time high, 1,741,535,000 pounds. Two hundred and ninety-seven brands are carried by grocers in New York City alone.

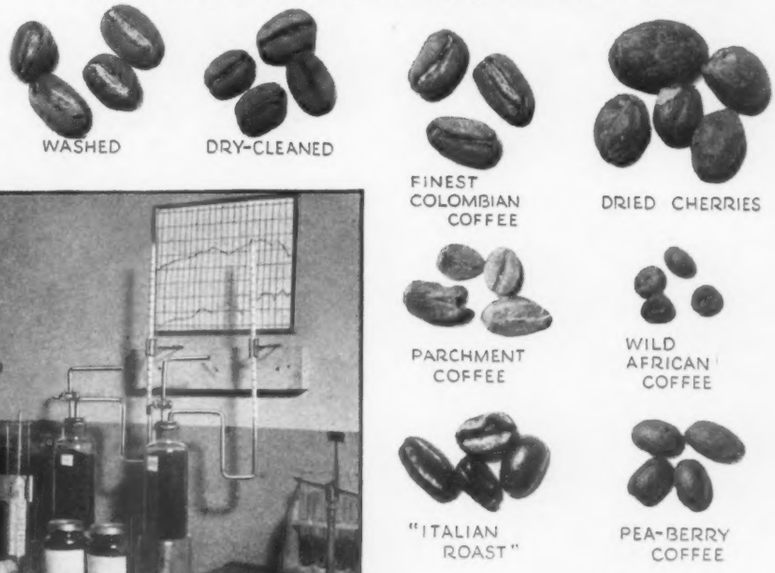
Almost daily, vessels steam into New York Harbor laden with green beans from tropical lands. Coffee grows in virtually every hot country in the world. According to legend, its peculiar properties were first discovered in Africa. An Ethiopian goatherd, noticing the friskiness of his animals after they had eaten leaves and berries from a shrublike tree, tasted the berries and found them invigorating. Later, he crushed them up and mixed them with tallow, using the hardened cakes for food. Many tribes in Africa still use coffee in that form.

In recorded history, the first mention of coffee was made in 875 A.D. by the Arabian physician Rhazes. Since that time, its use as a beverage has spread all over the world. In addition, there are coffee jellies, coffee soups, coffee sirups, and coffee cream pies. Compressed briquettes of gum coffee also provide fuel for locomotives. But queerest of all is a use reported from northern Brazil. Natives there soak coffee beans in water and employ the liquid, just as we do boric acid, as an eye lotion!

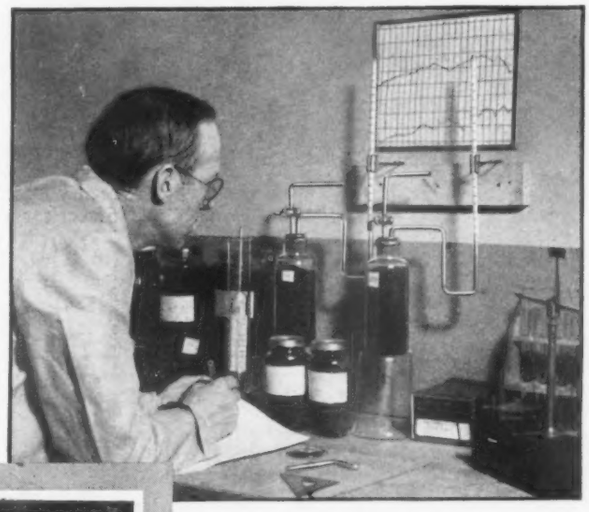
Most coffees of commerce come from cultivated plantations, although a small amount of wild coffee is imported from the East Coast of Africa. The trees are green the year around. They produce white, waxy blossoms and red, cherrylike berries. It is the seeds of these berries that form the coffee beans. From a mature grove, the yield is about 200 pounds per acre. Picked in large baskets, the berries are either dried or washed to eliminate the pulp, outer skin, and silverskin and leave the beans ready for market. In this state, they are either gray-green, bluish, or brownish and have little or none of the familiar coffee odor. The aromatic oils in the cells of the bean, which produce the distinctive odor and flavor of coffee, are brought out during the delicate process of roasting.

The leaves of a coffee tree, as well as the beans, contain the stimulating drug, caffeine. But *(Continued on page 98)*

Coffee berries being washed to remove the pulp, outer skin, and silverskin



Close-ups of coffee of various types, and at different stages of preparation



With this mercury-tube apparatus, a coffee expert can measure the gases given off by various coffees for purposes of comparison

This is the first step after the berries are picked

Dummy Plane Trains Army

Pilot in cockpit of dummy plane receives radio direction signals from near-by operator and maneuvers his ship accordingly

At left, after completing ground course in blind flying, the student takes to the air, flying in a training plane equipped with a hooded cockpit. An instructor seated in open cockpit in the rear acts as a check on the student's piloting. This phase of the training is known as "going under the hood"

View of the simplified panel of instruments used in the Army airplanes for blind flying. The reading of these instruments, plus the receipt of radio direction signals, give the pilot an accurate means for keeping a true course and for landing blind, when necessary

WAR DEPARTMENT plans to establish the nation's first line of defense 500 miles out over the sea moved a step nearer reality recently with graduation of the first class of students in the school of blind flying, conducted by the Ninth Bombardment Squadron at Rockwell Field, San Diego, Calif.

In this first sea-going school for the Army, crack pilots from pursuit, attack, and bombardment squadrons are enrolled. Here, without leaving the ground, the flyers are put through the paces of flying blind. After the ground course, the students are ready to fly 200-mile-an-hour bombers out to sea through the actual conditions of storm and fog.

In a miniature dummy training plane, which turns, rolls, and pitches as the rudder, flipper, and ailerons are moved, the student sits in darkness beneath a hood and follows radio beams reaching him from a buzzer just as though he were flying high above the earth.

Four compressed-air bellows, which inflate and deflate as stick and rudder bars are moved, give the miniature plane the same action as an airplane.

Every pilot must start his blind flying in this trainer. For two hours the student practices level flying, gentle turns, and glides, guided by his instruments and the voice of an instructor, who talks into a speaking unit not ten feet distant.

After he becomes adept at putting the model into any desired position, such as a stall, and recovering to normal flight, he starts his hunt for radio range signals. The instructor orders the student to find the north beam of the Rockwell Field radio

Pilots to Fly Blind at Sea

A ground crew is calibrating the compasses in an amphibian bomber. Such planes figure in the U.S. Army's plans for long-distance flights through fog and storm. Below, experts in the operations office at Rockwell Field operate a radio bearing finder to follow the direction of incoming radio signals and plot an airplane's course

beacon. Knowing his approximate location and altitude, he sets a straight, level course to intercept the beam.

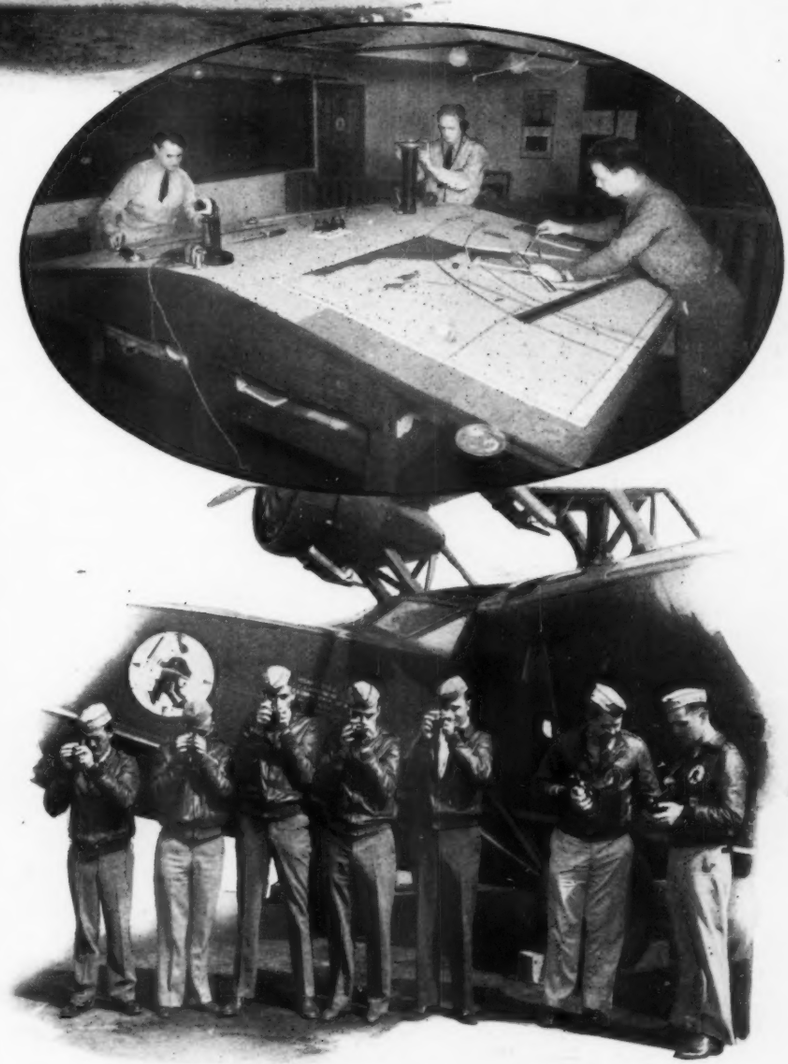
After four or five minutes of "flying," the instructor turns a crank which makes the beam audible to the pilot, who kicks right rudder and swings the ship south into the path of the signals.

As long as the student holds a true course, he hears a long dash, known as the on-course signal. Markers near the base of the plane show the instructor the exact compass direction in which the plane is headed at all times.

HAVING learned to rely upon the instruments, and signals pouring in through the earphones, the pilots go into the air in single-engine training planes to learn actual blind landings and dead-reckoning navigation. The students are also taught to take observations of sun and stars—a course of instruction similar to that given navigation officers aboard ships.

Finally, in Douglas amphibians, which can alight gracefully on a hard runway or ride out a storm at sea, the Army's flying aces make daily flights, far out over the ocean. As they fly, radio experts ashore plot the plane's course from radio signals which pour into a radio bearing finder. Before completing the course, each pilot must be able to fly blind 100 miles, and arrive within a quarter of a mile of his objective.

When, in a few weeks, a sufficiently large force of pilots becomes qualified for this precise flying, they will be assigned to bombing squadrons—ready to fly unerringly to meet an enemy long before he reaches our shores.



A group of student blind flyers are introduced to the sextant. Later, while flying at sea, one of the problems assigned to them will be to determine their position by the use of this instrument. All the school's graduates must be proficient in this method of navigating

Thrilling Mountain Rescues

PERFORMED BY A UNIQUE CLUB

ON THE SLOPES of Mount Hood, in Oregon, a howling blizzard was raging. While the storm was at its height, three exhausted hikers stumbled into a mountain inn and gasped out their story of distress. They had battled the storm in a vain search for a lost companion, until they were finally beaten back by the gale. The fourth hiker, young Calvin White, still was wandering among dangerous, snow-hidden glaciers on the mountain above.

Immediately, a call of distress was sent to the Crag Rats, volunteer mountain rescue organization, the only club of its kind in the United States. At the club headquarters in Hood River, Ore., forty miles away, the alarm brought immediate action. A score of experienced mountaineers tossed skis, snowshoes, and alpenstocks into cars, collected ice axes, ropes, and compasses, and quickly checked over their supplies of compressed food and first-aid kits. Within a few minutes, the Crag Rats had mobilized and were on their way.

At the inn, the lost boy's father greeted them with renewed hope. A quick conference was held, a plan for the search outlined, and the rescue party plowed out into the storm.

All day long they searched, and finally, on a ledge where old snow had been bared by the fierce wind, they found a track. Like hounds on a hot trail, they took it up, plunging down through timber and snowdrifts into a deep canyon. Here a lone, broken ski gave them encouragement, but soon the track was lost in the blinding, sleet-laden wind.

Through the night they tramped, covering every possible foot of the mountain side, the beams of their flash lights hardly penetrating the swirling snow, their voices but faintly audible in the roaring wind. At dawn, Crag Rat Bill Cochran spied a dark object half buried in a snowdrift behind a big log. It was young White.

Cochran stripped off his own warm outer clothes and put them on the boy, rubbed his frozen fingers and feet, and gave him first-aid treatment to restore circulation. When Cochran failed to rejoin the others, the Crag Rats followed his trail and found him shivering beside the lost boy. They stretched their parkas across alpenstocks, lashed White to this improvised stretcher, and carried him down to his overjoyed father.

An injured climber is moved slowly down a dangerous grade. This phase of rescue calls for strength, skill, and endurance

On many other occasions Crag Rats have gone into the near-by Cascades to find lost persons or rescue injured climbers. Their code is as strict as that of the sea. No SOS goes unheeded. Neither may any pay or reward be accepted, for mountaineering is a hobby with them. They spend their own money on rescue trips, finding reward in the satisfaction of saving lives and rendering service to others.

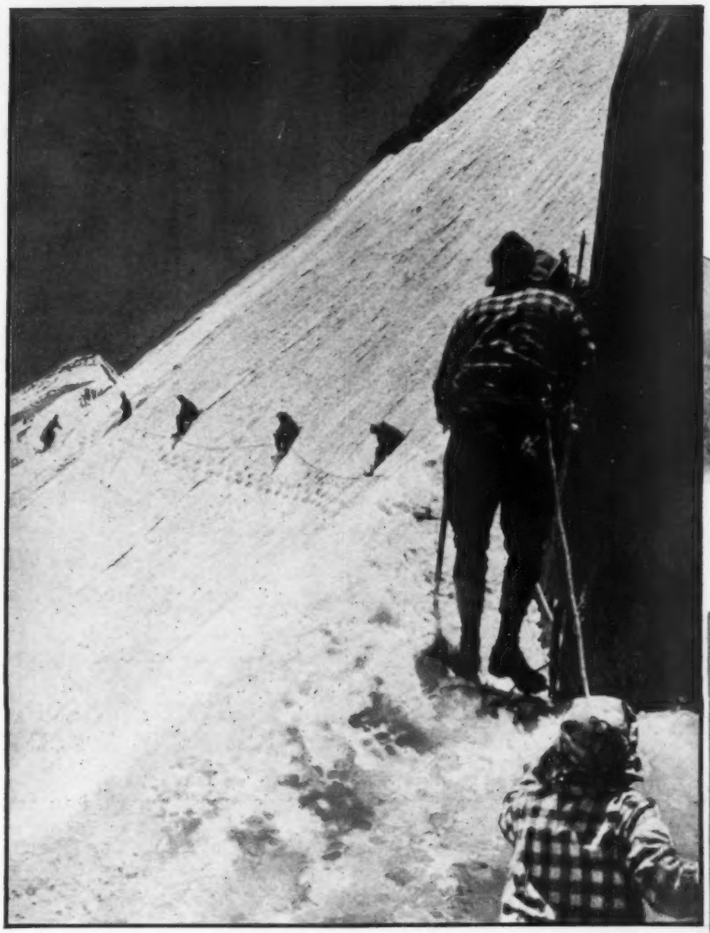
Hardly had the Crag Rats formed their unique organization when their first call came. Seven-year-old Jackie Strong was lost in heavily timbered, rough country at the base of Mount Hood, where the wind was icy and the glacial streams dangerous. Two nights and a day he wandered, traveling miles through the brush and scaling steep cliffs. Finally, the Crag Rats found him far up on the moraine of a big glacier.

Since then, Crag Rats have thrown their human net over the mountain many times to find lost persons. They have scaled precipices and descended on ropes into terrifying crevasses to bring climbers out safely.

A party of nine hikers, roped together, slipped on a steep slope, rapidly glissaded 600 feet over the ice, and fell thirty-five feet more onto a glacier split by dangerous crevasses. Crag Rats on the mountain below saw them fall and rushed to their aid. There was no time to gather equipment or send for help. Eight injured climbers and their dead companion were brought down that day

At the right, a party of Crag Rats starts the ascent to a rescue. Below is shown the compact first-aid kit carried for this work

No Call for Help Is Ignored by the Crag Rats, Veteran Mountaineers Who Aid Lost or Injured Climbers on the High Peaks of the Cascades



A roped party of Crag Rats progresses cautiously across a steep snow slope

CRAG RATS' RADIO
Stanley Rand, designer of portable radiophone set used by Crag Rats, shows its compact arrangement for field use and as pack luggage. The complete set, including its battery supply, weighs only twenty-eight pounds

By STERLING GLEASON

on stretchers improvised on the spot.

Again, a high-school boy slipped at the base of a perpendicular rock chimney and slid 2,500 feet down a glassy ice slope, landing on the Elliott Glacier below. Crag Rats picked their way across perilous crevasses and carried him down, after treating him for bad burns caused by his rapid slide across the ice.

It takes endurance, nerve, and good sportsmanship to be a Crag Rat. Ability to obey orders without question is essential, for on a rescue trip the leader has absolute authority and military discipline must be maintained. Membership is by invitation only. Of the hundreds who have made application, few have been accepted, and these only after a long trial period. The membership roll includes electricians, fruit growers, merchants, a banker, a druggist, a doctor, a photographer, and a retail lumberman, every one an experienced mountaineer, of splendid physique, and of unfaltering nerve.

To qualify, a man must have a good character and reputation in the community, and must keep in training by climbing at least one major peak each year. He must own an ice ax, a pair of skis, snowshoes, compass, and fur-lined parka. He must be skilled in first aid, know the fish and game laws, and be thoroughly familiar with the trails of the neighboring Cascade Mountains.

After a Crag Rat has climbed to the summits of the eight major peaks of the region—three of them in Washington and five in Oregon—he may qualify as a life member. Ten members have all these peaks to their credit, and some have made as many as sixty ascents.

Each Crag Rat specializes in some particular phase of mountaineering. Some are good high-climbers and can make hair-raising ascents where few men could go. Others take the lead in rock work or in ice traverses. Several are exceptionally good long-distance runners, valuable for rapid communication.

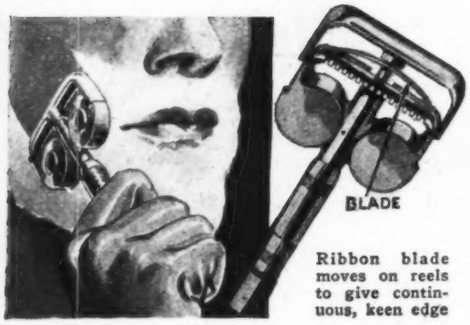
THE leader of a rescue line has a perilous and strenuous job. Long, rapid ascents with little fatigue are made possible by a simple routine developed by the Crag Rats. At each 100 paces, the man in front steps aside and lets the others pass him. He falls in at the end of the line. The next man repeats the process, resting in his turn. Thus each man gets frequent rests, while the line moves continuously.

Every member knows the trails and the topography of this rugged country, like the back of his hand. Each important formation is given a name. If a trail forks at a large rock that looks like a bear, the spot is christened "Bear Rock" and the name fixes the place in the memory. Compass bearings, taken on the summits of all important peaks and recorded upon Forest Service maps, guide them through fog.

Every short cut known to seasoned mountaineers is used to speed their work. Where a party had taken five hours to make a climb, Crag Rats reached them within one hour!

When a distress call comes in, an advance party goes ahead and reports to the base by radio. A portable outfit, designed and built by Stanley Rand, Hood River amateur, is carried. Weighing only twenty-eight pounds, including batteries, it has transmitted over distances up to twenty-five miles in open, and twelve miles in dense, timber. A special aerial is used, which may be simply stretched out on the ground or suspended from a near-by rock. The set operates on wave lengths ranging from three and eight tenths to ten meters.

When a fisherman was lost near Badger Lake, a ranger's car rushed a party of Crag Rats to the district. Working on a prearranged plan, they divided the territory between two groups, agreeing to meet again at a designated point. Finally, they found the lost man wandering about in the dense timber, miles from his camp. The searchers radioed the base and a car met them at near-by spot, saving a six-mile hike.



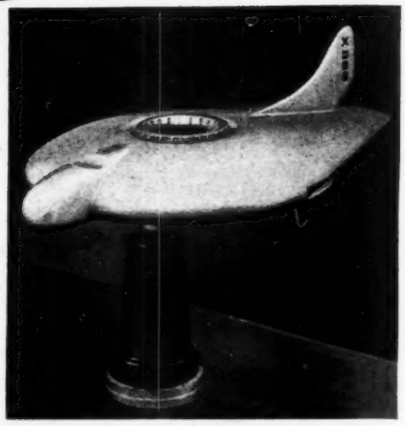
Ribbon blade moves on reels to give continuous, keen edge

RAZOR HAS RIBBON BLADE FIFTY-EIGHT INCHES LONG

A SAFETY razor with a fifty-eight-inch ribbon blade has been marketed by a British company. The blade is carried on two small reels and the exposed portion between them forms the shaving surface. When the exposed portion becomes dull, a twist of a knob on one of the reels brings a fresh section of the blade into use. The blade is made of rustless steel and requires no cleaning. The makers estimate that one blade will give the average man six months of comfortable shaving.

CENTRIFUGAL BLOWER PROPELS NEW PLANE

A REVOLUTIONARY airplane, having a motor-driven, centrifugal blower in the center of a flat, conical flying wing, has been designed by a disabled World War officer. The blower draws air from above and directs it at and under the upper wing. This air stream is provided to lift the craft vertically. For directional motion, retractable edges close spaces surrounding the fore part of the ship and force the air stream to the rear to propel the craft forward. Many novel features give the unusual aircraft a striking appearance.



Views of models of new-type airplane powered by centrifugal blower. Air intake is atop wing

LIGHTNING MAKES VASE

Fulgarite, formed by lightning, makes an unusual flower vase

GLASSY tubes resembling gnarled roots and hollow tree stumps were the aftermath of an electric storm at Garden Grove, Calif. Known as fulgarites, these curious formations were produced when lightning struck an electric-light pole and by its terrific heat melted the sand surrounding the pole's base. Their colorings shade from pea-green to deep pine-green. For as long as hours after the flash, the fulgarites were too hot to handle.

These pistols measure an autoist's response to an emergency

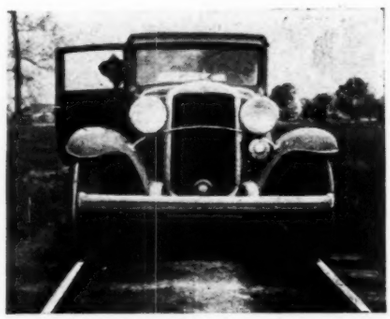
PISTOLS MEASURE SAFE CAR SPEEDS

Two revolvers, muzzles down and attached to the front bumper of an automobile, are used by Detroit, Mich., police to ascertain safe driving speeds for residential districts. The revolvers fire "red-paint" cartridges and their firing is controlled from the car. Under test, the firing of one is a signal for the driver to stop. When he steps on the brake, the second gun is discharged. The distance between paint marks on the pavement indicates the driver's reaction to an emergency situation.

BICYCLE USES ADDED ARM POWER

Rider pedals novel bike with hands and feet. Pedals replace handle bars

A DUAL-DRIVE bicycle—one that uses arm as well as leg power—is the invention of a Los Angeles, Calif., cyclist. Using an old bicycle for the parts needed, he obtained a center-drive sprocket with its attached frame bar. This he bolted to his bicycle in place of the handle bars. The front wheel has both free-wheeling and braking features. Once the rider has learned to avoid a wabbling motion, the arrangement gives greater speed and provides exercise for the arm muscles as well as for those of the legs.

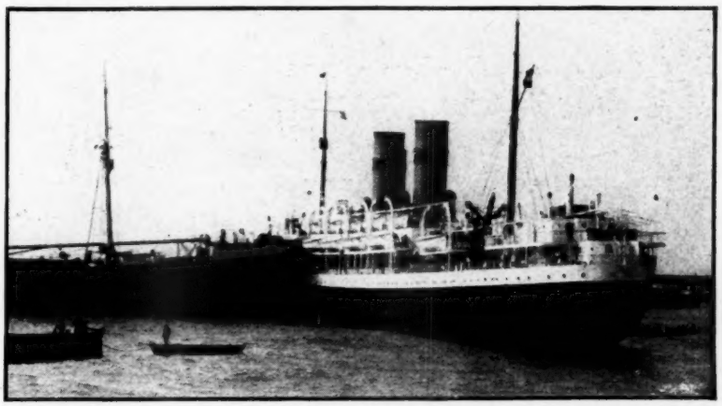


BALLOON-TIRED AUTOS RIDE RAILROAD TRACKS

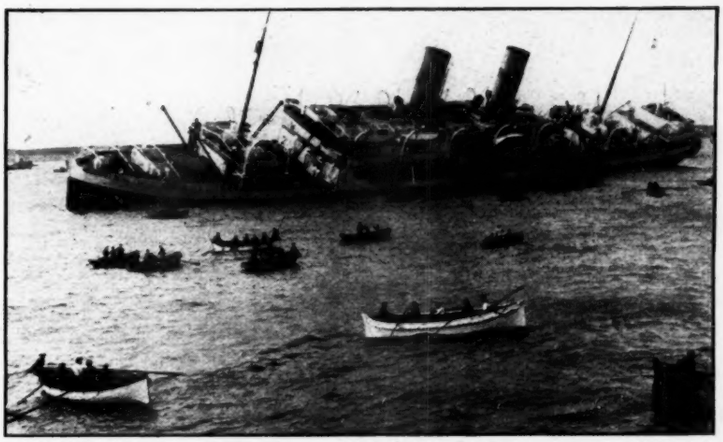
WHEN floods made Arkansas roads impassable, venturesome motorists took to railroad tracks. Experimenting to see whether the idea had practical value, engineers found that a car of fifty-six gauge fitted with balloon tires could hold the rail with ease as long as the steering wheel was left alone. Any attempt to steer, however, meant derailment.

REMARKABLE PHOTOGRAPHS SHOW STEAMERS IN COLLISION

JUST what happens when two steamships collide, is shown in the remarkable series of photographs reproduced at the right. A photographer happened to be on the job, recently, when the Portuguese vessel *Loanda*, entering the harbor of Leixoes, Portugal, struck the Dutch liner *Orania* lying at anchor. After the collision, the *Loanda* backed away, leaving the other steamer with a gaping hole in her plates amidships. While rowboats and launches quickly removed her passengers and crew, the *Orania* listed rapidly to port and finally came to rest on her side as shown in the last of the photographs. Only thirty minutes elapsed from the moment of the collision until the *Orania* had capsized. The *Loanda* was able to proceed to her anchorage, scarcely damaged by the crash.



This picture shows the prow of the *Loanda* striking the *Orania* squarely amidships



Left with a gaping hole in her side, the *Orania* lists to port and settles rapidly

Just thirty minutes after the blow was struck, the liner comes to rest on her side

SODA STRAW FLAVORS DRINK

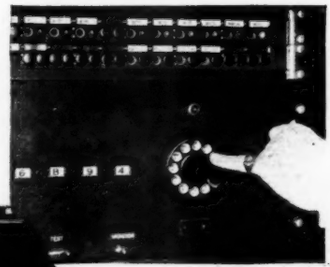
A SODA STRAW that imparts a flavor to plain water drunk through it, or gives a blended effect when used with prepared drinks, has been developed by a Miami Beach, Fla., inventor. Resembling an ordinary soda-fountain drinking straw, it is coated on the inside with a sweetened, concentrated flavoring substance, which dissolves in the liquid drawn through the straw. By drawing cold water through a lime-flavored straw, the inventor claims, the user gets an excellent drink of limeade.

Flavoring substance inside straw dissolves in beverage

HOTEL GUESTS DIAL FOR MUSIC

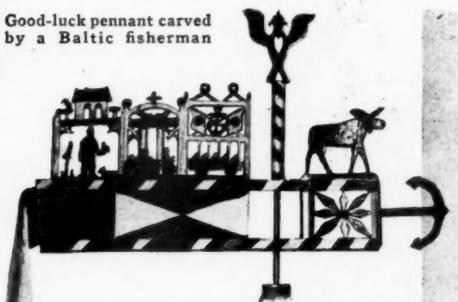
GUESTS of a New York City hotel may hear any desired musical selection played on a phonograph, or tune in on any local or short-wave radio program, merely by operating a telephone-type dial that is a part of a reproducing outfit in each room. The management supplies a printed list of selections available on phonograph records, and of broadcasting stations. The guest dials a number appearing opposite the selection or program he wishes to hear. The number is flashed on a board in the control room, and an operator starts a turntable playing the record, or connects the guest with the radio program desired.

Operator in control room uses dial to connect guest with program desired. The numbers in slots denote his selection



Below is shown the reproducing set, with dial by which the guest orders his music

Good-luck pennant carved by a Baltic fisherman



FISHING BOATS CARRY WOODEN PENNANTS

BOATS of the German fishing fleets on the Baltic Sea carry artistic wooden pennants at their mastheads. Carved by the fishermen during the idle winter months, these elaborate ornaments are supposed to bring good luck and to safeguard the vessels against shipwreck. The designs are cut with a fret saw.

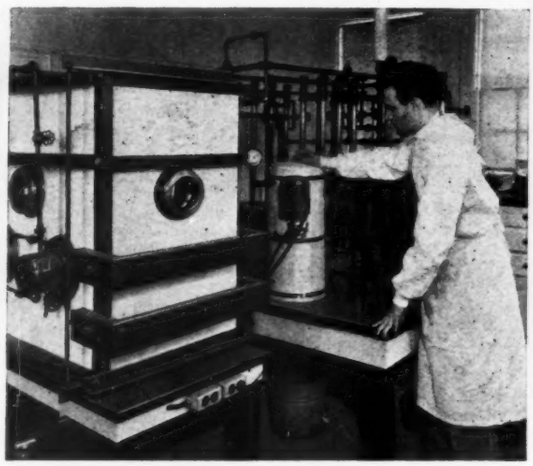
Fishing boats at anchor, with pennants at their mastheads

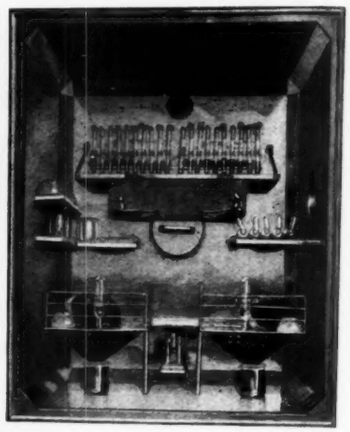
GERM-FREE GUINEA PIGS RAISED FOR STUDY OF DISEASE

This guinea pig is free from bacteria

BY RAISING guinea pigs that are absolutely free of germs, University of Notre Dame research workers have become the first to succeed in performing an experiment suggested as long ago as 1880 by Louis Pasteur, famous French bacteriologist. The unprecedented feat now makes it possible to inoculate an animal with a single virus and study the effects without interference from other bacteria. Preventive and curative preparations may thus be developed for human diseases that until now have baffled science, because the organisms responsible could not be isolated and identified. The guinea pigs that serve as living test tubes are delivered by a Caesarean operation, in a germ-free operating chamber. Transferred to a sterile, air-conditioned cabinet resembling a diving bell, where germs floating in the outside air cannot reach them, they get their first meals from a "glass mother" containing a synthetic guinea-pig milk. Later, solid food, carefully sterilized, is passed in to them through portholes by scientists wearing rubber gloves, as if for an operation. According to Prof. J. A. Reyniers, who perfected the technique of the experiments, these animals appear to be healthier than those in normal surroundings.

With his hands incased in rubber gloves, a scientist examines the guinea pigs inside the germ-proof cage. At right, regulating the air-conditioning equipment of the cage





Interior of cage, showing guinea pigs

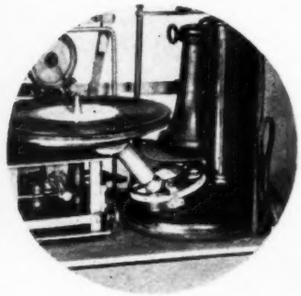
PRISON DOOR HAS DETECTOR FOR WEAPONS

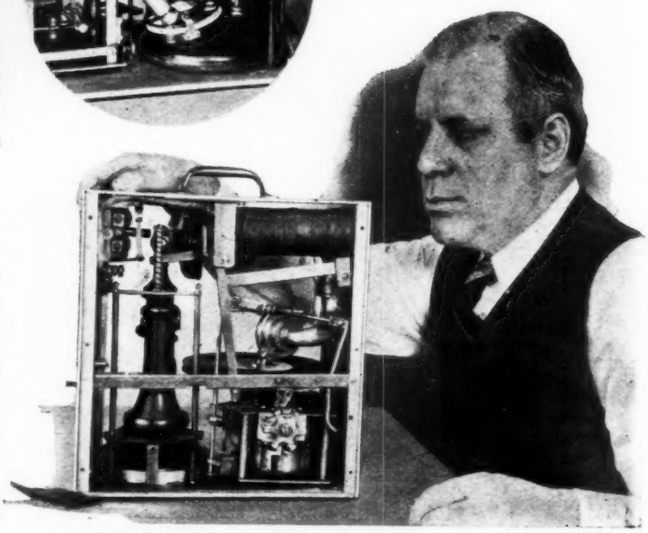
TO FOIL attempts to smuggle weapons into prison, a new electrical detector consists of three parallel loops of metal, concealed in the framework of a doorway. Current set up in the center loop is picked up by the two outer ones. Anyone walking between a pair of loops with a metal object concealed on his person upsets the electrical balance, automatically flashing a warning light.

Hidden pistol revealed by prison device

PHONOGRAPH GIVES FIRE ALARM

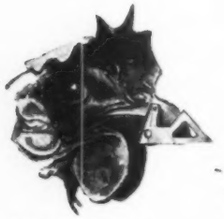
OFFICE buildings, apartment houses, and factories are guarded against fire by a robot watchman recently demonstrated in New York City. Sensitive thermostats, installed at key points of the building, detect the first flames and set the central mechanism in action. It automatically lifts a telephone receiver, dials the operator, and plays a metal phonograph record that reports the fire. The record also gives the address of the building and, if desired, the particular room or floor. The unit is small and convenient to set up.





Actuated by thermostats, this robot watchman telephones an alarm when a fire breaks out. Phonograph shown in circle tells the location of the blaze

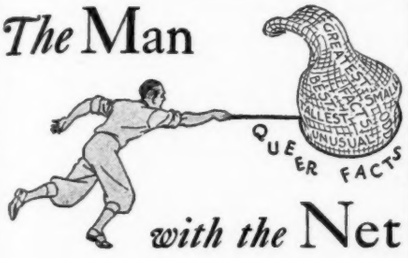
MUZZLES FOR CHICKENS PREVENT FIGHTING



Metal shield pinned to chicken's beak discourages fighting. It does not hinder eating or drinking, as it swings out when the head is bent

MUZZLES for chickens are a novelty introduced by a Seattle, Wash., firm to prevent fowls from pecking one another. The device consists of a small metal shield to be pinned to the beak, so hinged that the muzzle swings out of the way when the chicken lowers its head to eat or drink. When its head is raised, the muzzle drops into place and fully shields the end of the beak.

The Man with the Net



BEETLES *compose the largest family in the world.*

A SCHOOL *for inventors has been opened at Stockholm, Sweden. The tuition for the course is twenty dollars.*

BLUE WHALES *have stomachs large enough to hold several full-grown men, but their throats permit them to swallow nothing larger than small fish.*

SARGASSO SEA *water is the clearest found anywhere in the Atlantic Ocean.*

PHOTOGRAPHIC PLATES *are now made twice as sensitive as the human eye.*

ELECTRIC *smell meters are used by British sportsmen to determine the best days for trailing with fox hounds.*

OYSTERS *were cultivated by man before the birth of Christ.*

AMERICA *uses twice as much petroleum as drinking water in a given period.*

GIRAFFES *sometimes have hides an inch thick. Tanned, they outlast the hide of the rhinoceros.*

GOLD *is so ductile that a 900-mile wire, it is estimated, could be drawn from a single pound of the metal.*

GRAVESTONES *from cemeteries in Moscow, Russia, were cut into blocks and used to face a new embankment built along the Moskva River.*

ELECTRIC NETS *to catch fish more easily and cheaply are a recent invention of Soviet scientists detailed to advise fishermen in the Barents Sea.*

AUTO ATOP TALL POLE IS CAR WRECKER'S SIGN

A SMALL automobile that appears at a distance to be flying through the tree tops attracts curious passers-by to a Philadelphia, Pa., lot. Those who satisfy their curiosity discover that the car is securely guyed atop a lofty pole. They also learn that the elevated car stands as a monument in an automobile graveyard. More important to the resourceful junk dealer who erected it, the motor car advertises the automobile-wrecking business he has established on the site.

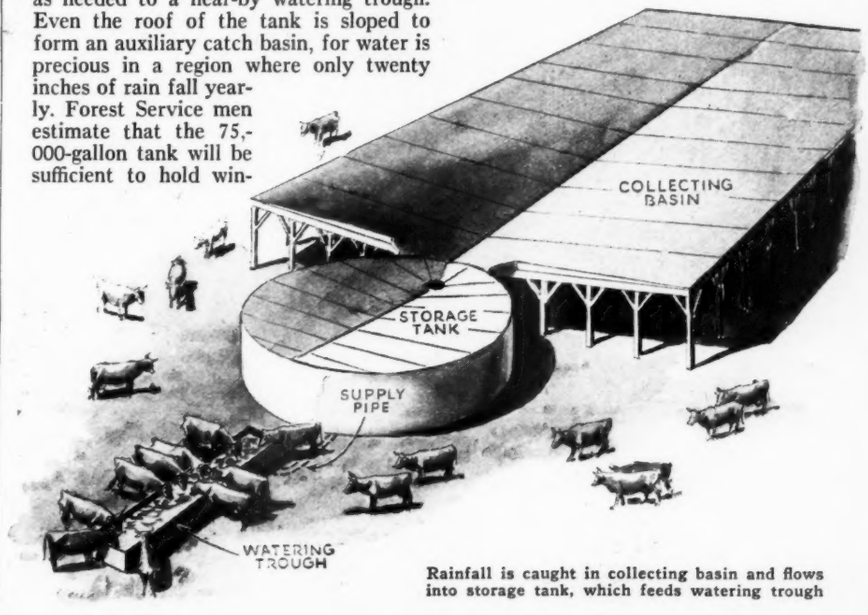
GUNLIKE DEVICE READS TEMPERATURES QUICKLY

SHAPED like a submachine gun, a new temperature-measuring instrument has been introduced for electrical workers. When its muzzle is pressed against the object whose temperature is to be tested, and held in this position for a few seconds, a sensitive thermocouple or electric thermometer, built into the working end, registers a reading by means of a needle on a dial. The meter reading requires no further calculation. The instrument will thus detect hot contacts or conductor bars of insufficient electrical capacity. To protect the user, the pistol-grip handle of the device is effectively insulated from the rest of the appliance.

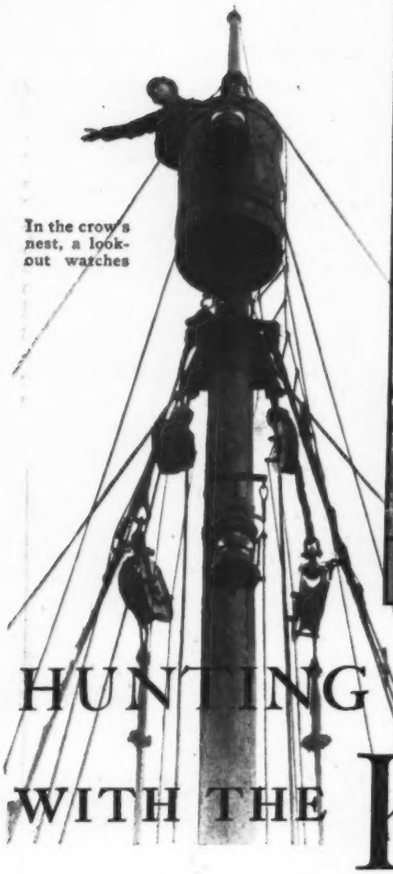
When the end of this device is held against an object, the dial shows the temperature

BIG RAIN CATCHER SERVES ARID RANGE

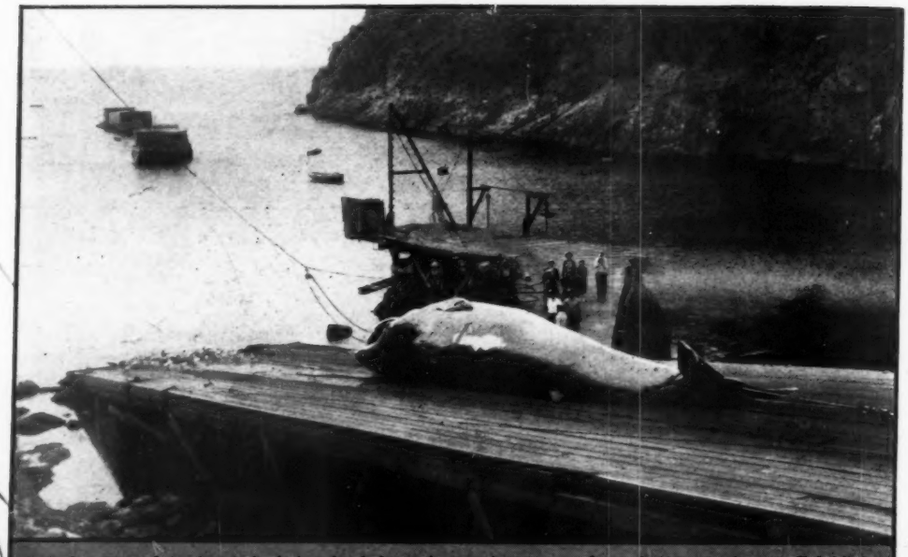
SEEKING new sources of water for livestock, U. S. Forest Service experimenters have constructed a giant "rain barrel" near Albuquerque, N. Mex. A sloping metal roof, 120 feet long and 100 feet wide, catches rain and drains it into a storage tank, from which it is delivered as needed to a near-by watering trough. Even the roof of the tank is sloped to form an auxiliary catch basin, for water is precious in a region where only twenty inches of rain fall yearly. Forest Service men estimate that the 75,000-gallon tank will be sufficient to hold winter precipitation for use in the spring, and summer rains for use in the fall, yielding a total of 135,000 gallons annually. Such rainfall catchers are relatively inexpensive to build and can be set up anywhere on a range, making it unnecessary to pipe water for long distances.



Rainfall is caught in collecting basin and flows into storage tank, which feeds watering trough



In the crow's nest, a lookout watches



A forty-ton finback whale being hauled to the cutting room of a whaling station at Trinidad, Calif. Many of the kills are handled by floating factories which follow the killer ships to sea

HUNTING WORLD'S BIGGEST GAME WITH THE Killer Ships of the

FIFTY miles west of San Clemente Island, six hours out from San Pedro, Calif., two killer ships plowed through the mild morning sea. From the bridge of the *Hawk*, one of the 100-ton vessels, I could see nothing to excite my interest. Abaft our starboard beam, some twenty miles distant, the topmast of the *Port Saunders* was dimly visible on the horizon.

Six hours earlier, we had steamed away from China Point, on Clemente Island, bent on scouring the Pacific within a radius of 100 miles for whales. Behind us lay the factory ship *California*, a modern sea-going plant of 900 tons on whose decks within a short time such whales as we might catch would be reduced to marketable products.

Through winter gales and summer calms, the small whalers and the mother ship continue the search for the biggest game the world has ever known, often without seeing land during long periods. The killers of this flotilla work as far distant as 120 miles from the factory ship, scouting abreast along plotted courses until they come upon whales feeding or at play. Recently, several new whaling squadrons, armed with guns whose explosive harpoons can kill almost instantly the blue whale, largest found in any sea, have joined the world's whaling fleets for a widespread attack on these valuable mammals.

An explosive harpoon. Note barbs that spread to hold the whale securely

It was at nine o'clock on a sunny morning, during a recent cruise with the newer of the only two American whaling fleets operating today, that I stood on the bridge talking with Capt. F. K. Dedrick, wind-bronzed veteran whose deep-sea hunts extend back nearly two decades into the period when whalers operated from shore stations. The *Hawk* rolled easily through the mild swells under the drive of her new oil-burning engines. Above us the top crow's-nest lookout scanned the sea from his weather-worn barrel, his head turning rapidly so that experienced eyes might see long distances in all directions at virtually the same instant.

"Perfect weather for fishing," I commented to Captain Dedrick, "but where are the whales? Isn't this largely guesswork?"

"We're sure to find them some place," he replied. "Maybe not today, but tomorrow, sure. They travel certain roads. When they find food, they hang around for weeks. We could turn back and find California grays closer inshore, or we may steam on another fifty miles for finback or sulphur-bottom."

"Which may we spot today?" I inquired.

"Probably sulphur-bottom," he said. "Sulphur-bottom, you know, are called 'blue whales.' They're the biggest animals found anywhere. Sometimes they run up to 100 feet or a little longer. I caught one ninety-six feet long. We got 200 barrels of oil from that baby. I guess we earned the oil, though, because I chased him at full speed from eight in the morning until five that afternoon—nearly a hundred miles—before we could catch him."

"Chasing whales!" I exclaimed. "I thought you stalked them and shot them before they knew you were in the neighborhood."

"True enough," he answered, "but when they're hunting food some whales cruise along at a speed of eleven or twelve knots. Few killer ships, even at top speed, can move so fast. You see—"

His explanation was cut short by a shout from above:

"Blow! Aft on the quarter!"

The wheelsman looked up.

"Hard aport!" called the bronzed lookout.

As the ship came speedily about, the top crow's-nest man now watched the blue speck in the distance. From the bridge, I could see three thin streams of water spouted at regular intervals into the air.

When the bow swung directly toward the whale, the lookout called, "steady!" and we proceeded southeast on the new course.

"Must have passed him while he was running under water," Captain Dedrick explained.

From above came a new order: "Hook her up, full speed and a half."

As the propellers commenced to churn

THE WHALE'S WORST ENEMY
A modern harpoon gun, mounted at the bow of a killer ship. It fires a heavy, explosive harpoon into the side of the floating monster

With this giant hypodermic needle, the carcass of a whale is blown up so that it can be towed to the factory. Compressed air is used for this purpose

Whaling Fleet

By ANDREW R. BOONE

A typical killer ship, the *Port Saunders*. The harpoon gun can be seen at the bow

at top speed the lookout shouted an estimate of the distance: "He lies about three miles ahead."

The *Hawk* seemed to tremble beneath our feet as she leaped forward to the chase. All eyes were strained over the sea, hoping for a glimpse of the great mammal. Twelve minutes passed . . . thirteen . . . fourteen. Twice in this time, the whale blew in regular cadence three streams of water. By now, we lay 300 yards off the right side of the unsuspecting giant and an equal distance behind.

"Hard aport," sang the gunner, F. K. Dedrick, Jr., from the gun platform, to which he had moved during the swift run of the last quarter hour. "Line up the wake."

In two swift movements, the little ship swung in behind the whale, then slowed down until we were only crawling through the sea. We came up very slowly to the place where he had last blown.

For a distance of 200 yards we could see the wake, much like that left behind by a small boat or a torpedo running on the surface. Not a word did I hear spoken by any of the eleven members of the crew, all intent on the capture; the only sounds were the whirring of propellers and the slap of water against steel plates.

From my position on the foredeck, slightly behind the gun, I asked the gunner what direction the whale would take.

"Sulphur-bottom and finbacks usually go straight ahead," he explained, without taking his eyes from the green sea ahead.

Lashed alongside a factory ship, these humpback whales are being stripped of their blubber, which is hoisted aboard

"But sulphur-bottom may come up to blow about a point or so off the course they were following before going under."

"Watch either side," he shouted suddenly. "Dead slow."

Then he went on, as though his explanation to me had not been interrupted:

"Try to find his shadow in the water. This fellow's a sulphur-bottom. His color lightens the water, and if he's lying no deeper than two fathoms, we can see him 1,500 feet ahead."

Five minutes passed between the disappearance of the whale and our arrival in his wake. To my inexperienced eyes, it looked as though we might run him down, or come alongside so close as to frighten the monster away. But captain and crew stood nonchalantly at their posts, knowing better than I the proper course to pursue.

"If he's a good whale," the younger Dedrick *(Continued on page 100)*

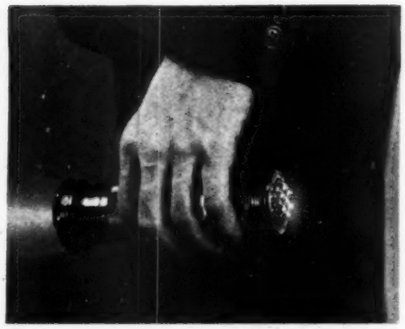
GUNNERS USE PICTURES FOR TARGETS

PAINTED landscapes serve as targets for machine gunners at the Fort Wayne, Mich., Army post, where a new training method obviates transporting gun crews and equipment long distances. Practice is held on a 1,000-inch range instead of the usual one of 1,000 yards, the gunners sighting and firing at the pictured objects as shown above. Holes in the targets give officers an easier means of checking the accuracy of fire than dust kicked up by bullets on open-country ranges.

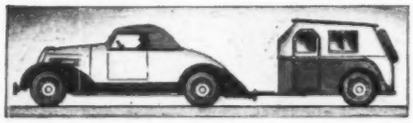
NOVEL MOTION COCKS AIR GUN

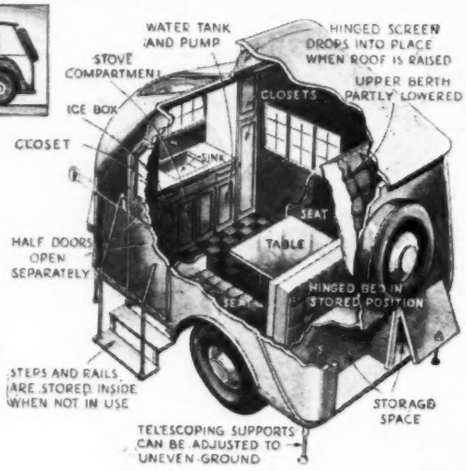
Inventor of new high-power air rifle shows how weapon is cocked

UNUSUALLY powerful and accurate performance is claimed for a novel air rifle recently built by a Macon, Ga., gunsmith for his own use. The gun is cocked in the manner shown at the right, and fires .22-caliber pellets. It has an overall length of thirty-four inches, including the rifled 19¼-inch barrel, and weighs seven pounds. Springs provide the power.



SMALL AUTO TRAILER SHELTERS THREE





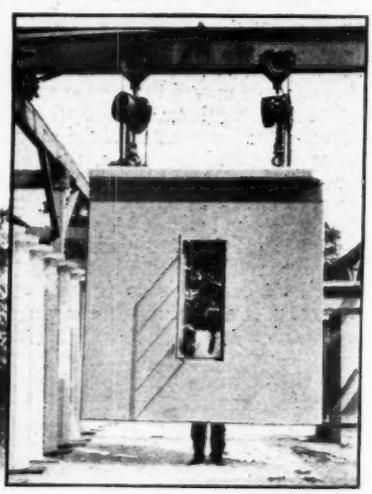
HOME comforts are provided in exceptionally compact space by an auto trailer designed by a Ridgefield Park, N. J., inventor, for cross-country touring and camping. Although it measures less than ten feet long and a little over six feet wide, space-saving equipment enables it to accommodate three persons without crowding. Ingenious mechanical features include upper and lower berths that slide out of the way at a touch, and a hinged roof that may be raised for ventilation.

FLASH LIGHT SHOWS RED LIGHT TO THE REAR

SHOWING a white light to the front and a red one to the rear, a handy new flash light offers protection to a pedestrian walking along an unlighted road at night. No additional current is used to illuminate the red signal, which consists of a tinted reflector that shines brilliantly in the rays of the headlight of an oncoming car approaching from the rear.

MOSAICS IN CONCRETE DECORATE PREFABRICATED HOUSE

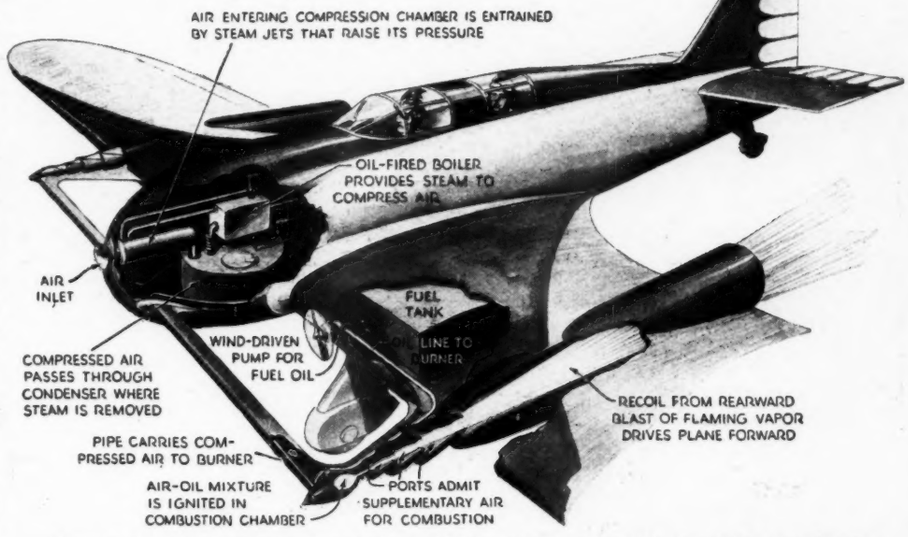
MOSAIC designs in concrete provide an unusual decorative touch for a new type of prefabricated house developed by a Washington, D. C., architect. The patterns are formed from stony particles selected for their fadeless color, no pigments being used, and are embedded in the concrete at the time the slabs are cast. When the concrete has hardened, the surface is scraped with a wire brush and washed with weak acid, exposing the design. Panels of the precast concrete are used to form the walls of the dwelling, and are joined by reënforced concrete pillars.



A slab cast for a prefabricated house, with mosaic design under the cornice. At the left, the completed house is seen

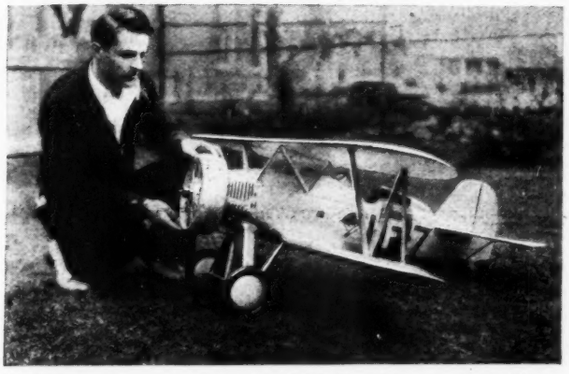
Flaming Jets Drive Novel Aircraft

DRIVEN by blast nozzles, a rocketlike airplane designed by a French inventor is declared to make possible speeds of 600 miles or more an hour. A mixture of fuel oil and compressed air is fed to these nozzles and ignited, and jets of flaming and expanding vapor spurt rearward with terrific force, the recoil driving the machine forward. To supply air at high pressure, the inventor has devised a novel method that dispenses with conventional compressors. It employs, instead, a jet of steam from an oil-fired boiler, which entrains outside air and forces it under pressure into the supply system, the steam being condensed and the water drained off before the air reaches the burners. Since there are virtually no moving parts, the novel power plant is declared to offer practically no chance of mechanical failure. The plane has no motor in the accepted sense of the word.


AIR ENTERING COMPRESSION CHAMBER IS ENTRAINED BY STEAM JETS THAT RAISE ITS PRESSURE
OIL-FIRED BOILER PROVIDES STEAM TO COMPRESS AIR
AIR INLET
FUEL TANK
WIND-DRIVEN PUMP FOR FUEL OIL
COMPRESSED AIR PASSES THROUGH CONDENSER WHERE STEAM IS REMOVED
RECOIL FROM REARWARD BLAST OF FLAMING VAPOR DRIVES PLANE FORWARD
PIPE CARRIES COMPRESSED AIR TO BURNER
AIR-OIL MIXTURE IS IGNITED IN COMBUSTION CHAMBER
PORTS ADMIT SUPPLEMENTARY AIR FOR COMBUSTION

Drawing shows design of new French plane which is driven by rocketlike jets of flaming oil spray.

KITS MAKE GAS-DRIVEN MODEL PLANES



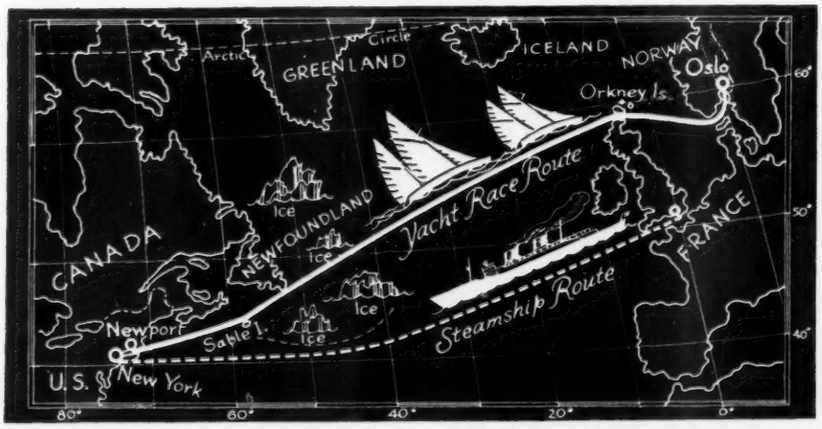
Gasoline-powered airplane model built with a new-type kit

GASOLINE-POWERED miniature aircraft, the aristocrats of the model kingdom, are now possible for anyone to build, with the introduction of kits for home assembly. The craft shown at the left is a one-fifth scale model of a Navy pursuit plane, and flies for about four miles on its tank's capacity of one ounce of gasoline. The plane and its one-fifth-horsepower motor have a combined weight of only three and a half pounds.

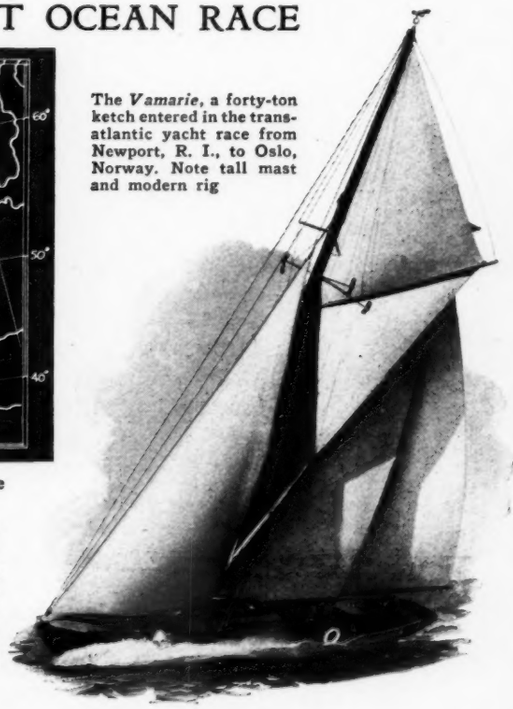
PIPE HAS THREE BOWLS

SUITED for a short smoke or a long one, a pipe recently invented has three bowls, any one of which may be opened for use by revolving a clover-leaf cover. A small bowl provides a few puffs when there is no time for more. Two larger bowls are available for the smoker to choose from when a more leisurely smoke is desired.

TINY YACHTS COMPETE IN LONGEST OCEAN RACE



The course of the transatlantic yacht race compared with the main steamship route



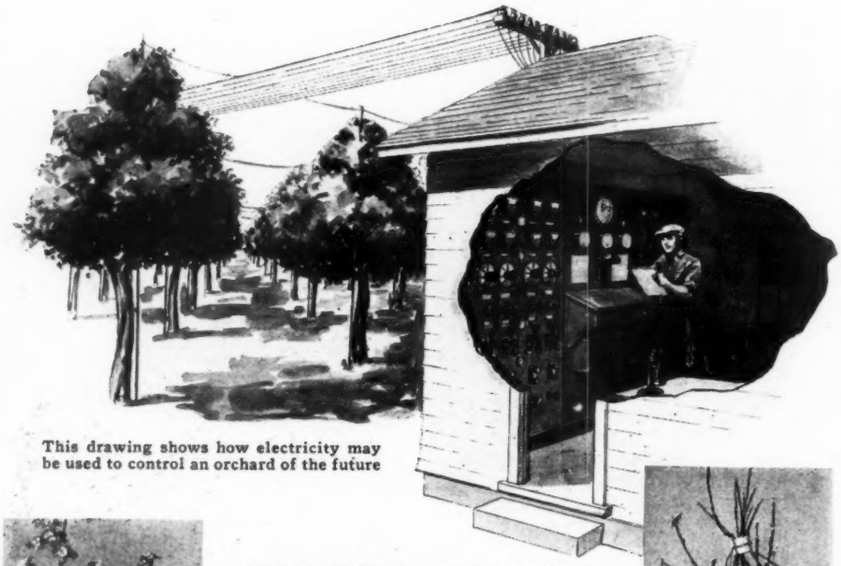
The *Vamarie*, a forty-ton ketch entered in the transatlantic yacht race from Newport, R. I., to Oslo, Norway. Note tall mast and modern rig

DESIGNED especially to compete in the longest ocean yacht race in history, a fleet of craft assembled recently at Newport, R. I., seemed small and frail to old-timers. Modern advances have dispensed with excessive size and cumbersome sails in the forty-ton ketch *Vamarie*, a typical contender. There is no long bowsprit forward, nor does the boom overhang the stern; the towering sails, all inboard, give driving power where it is needed. Stainless-steel wire replaces tarred ropes for handling the sails and rigging, and modern mechanical aids obviate the need for a large crew.

FROZEN GUINEA PIG REVIVED IN ODD TEST

FREEZING a guinea pig and then reviving it, was a recent accomplishment of Dr. Ralph Willard, research chemist of Hollywood, Calif., during experiments to probe the mysteries of suspended animation. After having been frozen and kept in this condition for three days in an air-tight ice box, the animal was thawed out, and scampered about as if nothing had happened. The photograph shows the experimenter with a guinea pig that he has revived, and another that he has frozen for a similar test. Experiments of this kind have been successfully performed before with frogs and other cold-blooded animals, but the present series of tests with warm-blooded creatures is reported to constitute a step forward in this little-explored field of research.

ELECTRICITY CONTROLS TREE GROWTH



This drawing shows how electricity may be used to control an orchard of the future

Tree at left shows result of stimulation by electric current

ELECTRIFIED orchards are forecast by Georges Truffaut, French experimenter. Attaching wires from a forty-volt battery to seedling trees, he found their growth markedly stimulated when the current passed upward through the stems and branches. Reversing the flow retarded their development. Similar results could be obtained, Truffaut suggests, by fitting full-sized fruit trees with metal collars, connected to a suitable source of direct-current electricity. Thus a grower could retard the development of fruit to protect it against unseasonal frost, or hasten its ripening when conditions were favorable. To explain his observations, Truffaut offers the theory that the electric current alters the rate at which sap rises.

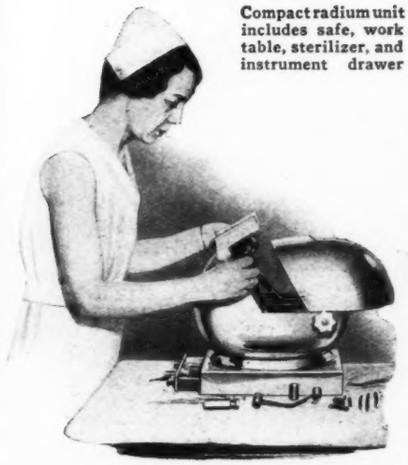
Downward flow of current retarded flowering of upper branches

PUMP INFLATES COLLAPSIBLE GAS-PROOF SHELTER

TO PROTECT civilians against a war-time attack with poison gas, a French inventor has devised a portable shelter that may be set up with a few strokes of a pump. Made of gas-proof balloon fabric, the "pneumatic shelter" is ready as soon as inflated. An air lock permits entrance to the interior, which may be illuminated and comfortably furnished. Air within the chamber is renewed chemically or replaced by filtered air from outside. The inventor has also designed a large shelter to accommodate several hundred persons, which draws fresh air from a stack reaching above the level of low-hanging gas clouds.

Interior of folding gas-proof shelter. Persons are admitted through an air lock in the door

At the left, the shelter deflated, and the hand pump that is used in filling the fabric bag with air



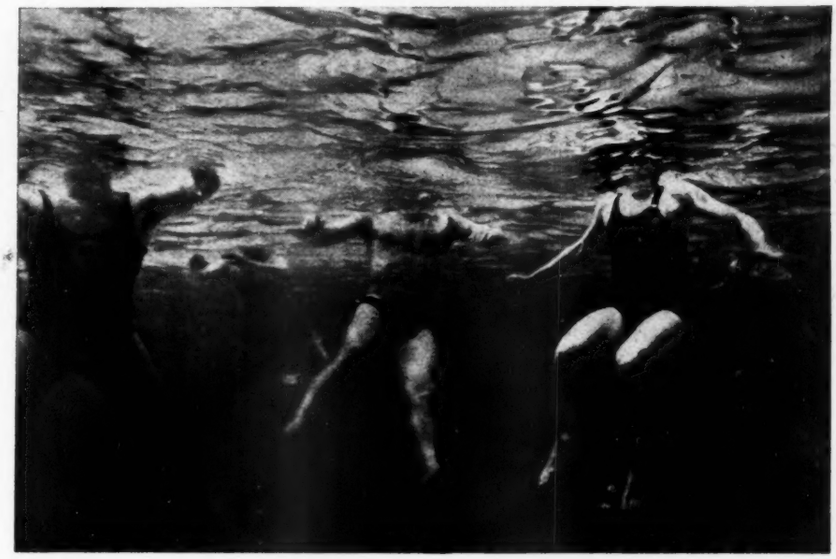
Compact radium unit includes safe, work table, sterilizer, and instrument drawer

GUARDS RADIUM WORKERS

A NEW safe for radium has walls of lead six inches thick to shield hospital workers from prolonged exposure to its powerful rays. A knob rolls back the massive cover, and a lead-glass plate, three-quarters of an inch thick, protects the nurse's face as she works. The safe combines storage compartment, work table, instrument drawer, and sterilizer.

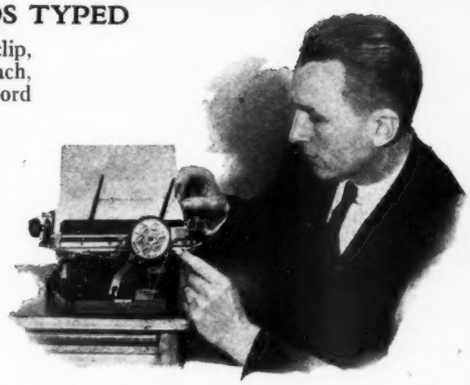
UNDER-WATER VIEW GIVES ODD EFFECT

USING a submarine camera, a French photographer recently snapped the striking photograph of a water-polo game reproduced below. The "fish's-eye view" caught most of the players with their heads above water and their apparent decapitation is explained by reflections that make anything above the surface invisible. A surprising effect may be obtained by turning the picture upside down.



DEVICE COUNTS WORDS TYPED

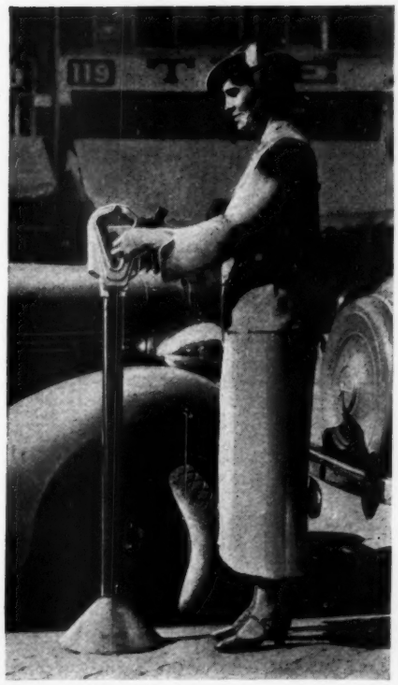
FROM an old water meter, a paper clip, and a few homemade levers, a Long Beach, Calif., student has constructed a "word tally" that automatically counts the number of words written on his typewriter. Commercial application of the device, he suggests, would save untold labor where the length of articles is determined by counting the words of the finished manuscript. His device will record up to one million, and is provided with a finger button by which words that are erased may be subtracted from the total.



USE ARTIFICIAL FOGS TO TEST LAMPS

FOGS are made to order, in a glass-enclosed cabinet at a Bloomfield, N. J., laboratory, to test the ability of different types of lamps to penetrate haze and smoke. Any desired fog condition may be reproduced, and an illumination meter registers the amount of light reaching it from a lamp set up at the opposite end. Tests indicate the effectiveness of raising the voltage of lamps during fog.

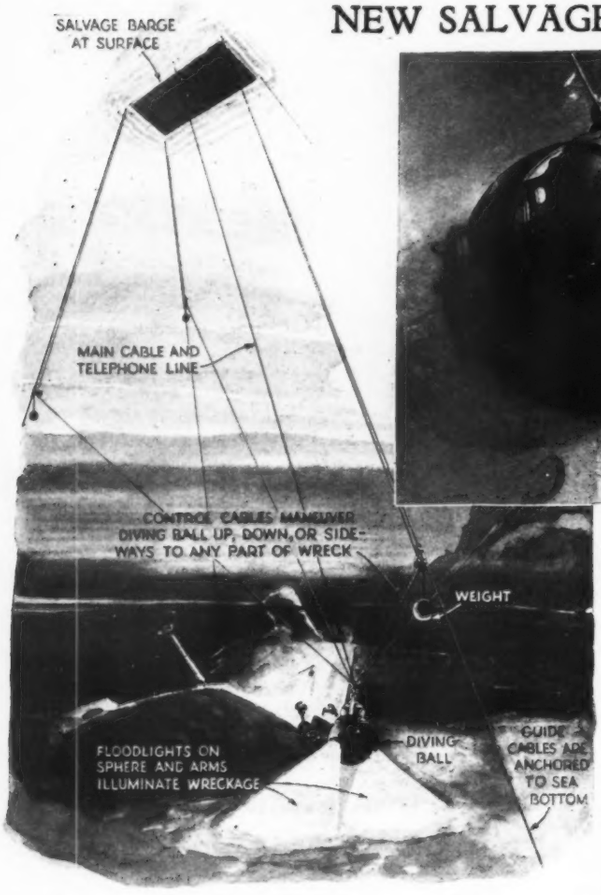
Any fog condition can be reproduced in this cabinet to test the ability of different lamps to penetrate



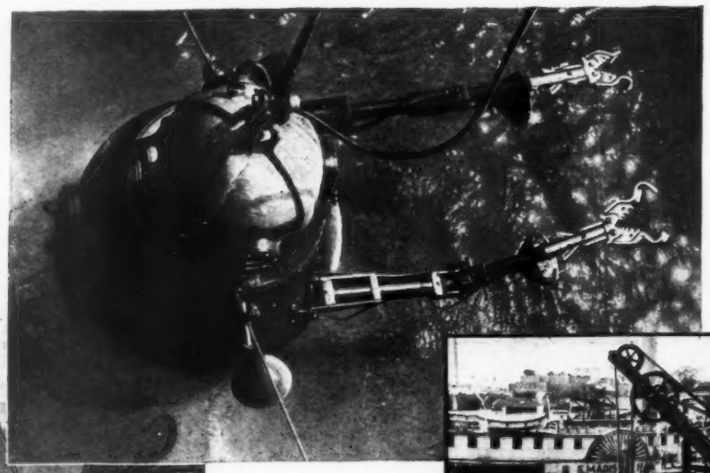
CURB-PARKING METER TIMES AUTOIST'S STAY

TO FACILITATE enforcement of parking limits, Oklahoma City, Okla., contemplates charging motorists for street parking, using a newly invented meter. Depositing a coin and twisting a lever, as shown above, raises a green flag in the meter, which entitles one to park for a limited time. When this expires, the flag drops from sight. Its telltale absence informs patrolmen that the car has overstayed. The motorist may renew his privilege by inserting another coin.

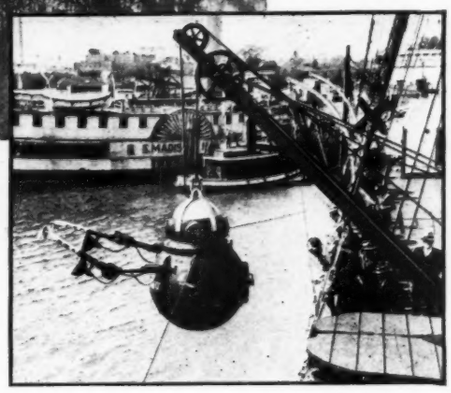
NEW SALVAGE DEVICE HAS ARMS AND HANDS


SALVAGE BARGE AT SURFACE
MAIN CABLE AND TELEPHONE LINE
CONTROL CABLES MANEUVER DIVING BALL UP, DOWN, OR SIDEWAYS TO ANY PART OF WRECK
WEIGHT
FLOODLIGHTS ON SPHERE AND ARMS ILLUMINATE WRECKAGE
DIVING BALL
GUIDE CABLES ARE ANCHORED TO SEA BOTTOM

Picture at left shows arrangement of cables from salvage ship to the submerged diving sphere. This rigging enables mother ship to move sphere up, down, or sidewise in response to the signals given by the diver



These six-foot arms, controlled by diver in sphere, can perform many intricate operations with the mechanical hands



A salvage ship, shown below, lowers the diving sphere over its side. Diver can go down 2,500 feet

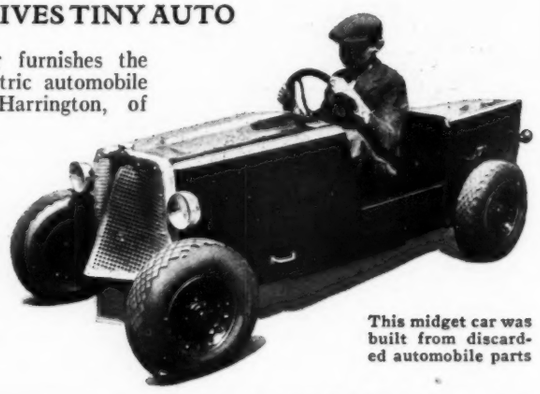
SOON to be used in a search for sunken treasure, a new salvaging system recently was demonstrated at Washington, D. C. When a sunken vessel holding bullion is located, four cables anchor the salvage ship. Auxiliary cables then lower a one-man diving sphere and move it to any part of the wreck. The diver attaches salvage buoys or pontoons to the vessel, which is ultimately raised to the surface by pumping air into the buoys. Oxygen and air-purifying apparatus within the sphere enables the diver to stay submerged for sixteen hours. The steel ball is strong enough to withstand sea pressure at a 2,500-foot depth, and has movable six-foot arms to which twelve different implements may be attached and manipulated with amazing dexterity. With them, the diver can lift half-ton weights, tie knots in inch-and-a-half steel cable, and drill three-inch holes through ship plates. To demonstrate still more convincingly the maneuverability of the arms, a skilled operator recently performed the stunt of playing bridge, readily picking up and laying down the cards with the versatile "hands."

SPRAYER PUMP OPERATED BY USER'S LEGS

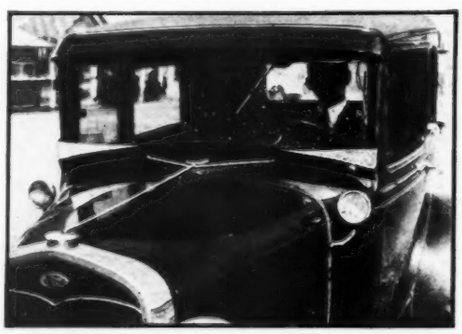
A SPRAYER pump actuated by the user's own weight is the conception of a Fresno, Calif., inventor. Instead of the conventional compressed-air tank, which the operator must set down and pump up from time to time, foot-power air pumps are used to supply the necessary pressure. To each of the user's boots is strapped a cylinder with a spring piston, and at every step a heelplate drives the piston home and supplies air to operate a knapsack-type sprayer of the kind ordinarily used in fruit orchards.

STARTER MOTOR DRIVES TINY AUTO

A DISCARDED starter motor furnishes the power to drive a midget electric automobile that twelve-year-old Dean Harrington, of Schenectady, N. Y., built for himself from scrap parts. The motor takes its current from a fifteen-plate storage battery and carries the boy and his father along a level road at twelve miles an hour. Parking lights serve as headlights, and the miniature car is also equipped with a tail light and horn. A hand lever operates a brake on a rear wheel.



This midget car was built from discarded automobile parts

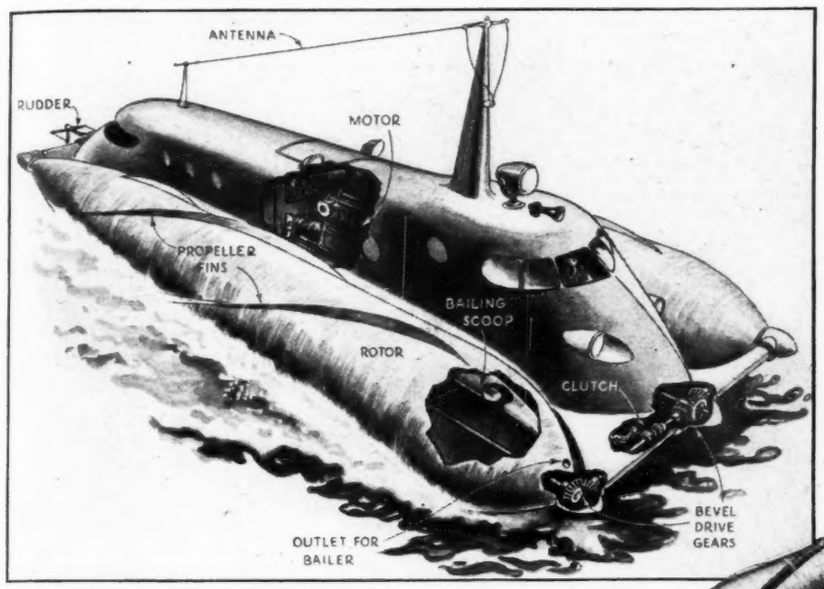


A tank above windshield sends down a sheet of water

TANK SPREADS FILM OF WATER ON WINDSHIELD

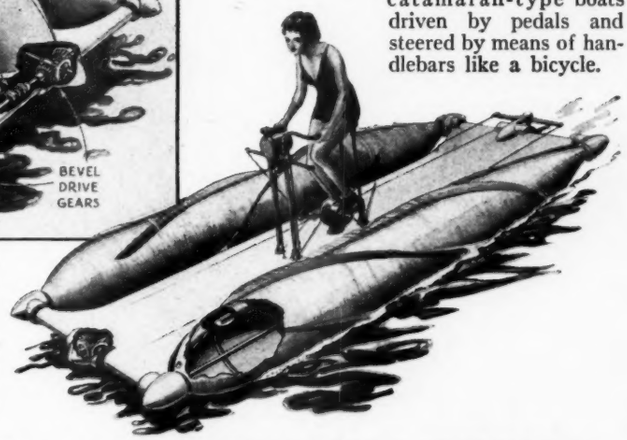
A NOVEL hot-weather motor accessory pours a thin sheet of water down the outside of the windshield from a concealed tank in the car roof. According to the inventor, evaporation of the water not only cools the windshield but also lowers the temperature of air that enters the open side windows. A valve above the driver's head controls the flow of water, which is drained off through the radiator and cooling system.

Boat Is Driven by Self-Bailing Rotors



Drawing shows novel features of new rotor boat. The rotors are controlled independently by means of clutches. Note the ingenious self-bailing feature

TORPEDO-SHAPED rotors fitted with spiral fins propel a new-type motor boat designed by a Georgia inventor. Mounted on shafts on either side of the body of the craft, and extending for its full length, the rotors are turned by a drive shaft extending at right angles across the bow of the boat. A curled metal scoop inside each rotor automatically bails out any water that may seep in while the boat is in motion, and ejects it through an outlet in the nose. The rotors are operated independently by means of clutches, adding to the maneuverability of the craft. The idea has also been applied to small catamaran-type boats driven by pedals and steered by means of handlebars like a bicycle.



The same principle is applied to a smaller boat shown at right. The craft is driven by pedals and steered by means of handlebars

Metallic ornaments applied to various surfaces by pressing with an iron

ORNAMENTS IN METAL ARE EASILY APPLIED

DECORATIONS in metallic finishes are applied easily to fabrics, glass, leather, or any other base with a new material which is pressed onto the surface with a hot iron. Supplied in thin, limp sheets, this material can be cut in the most intricate designs with ordinary scissors. When properly applied, it becomes an integral part of the surface and can be stretched, creased, or wrinkled without breaking. Its use is suggested for articles of many kinds.

INDIANS TELL SECRET OF LONG-LASTING PAINT

How paintings of the Indians remain bright after 150 years of exposure on Southern California cliffs has just been divulged to scientists by old medicine men of the Mission tribes. The base of their colored paints is oil from seeds of the chilicothe, a wild cucumber.

CHEMISTS MAKE ARTIFICIAL FIREFLY

ON THE darkened stage of an auditorium in Schenectady, N. Y., recently, a glass tube gave off a luminous, blue-green glow, as General Electric Company laboratory workers demonstrated the secret of the firefly's light. The effect was produced chemically, using the same substances that are manufactured by natural processes in the firefly's body. It is estimated that the production of one lumen hour of firefly light in the laboratory requires twenty-five dollars worth of chemicals. From the human viewpoint, the firefly's plant is inefficient.

The large tube contains the chemical equivalent of a giant firefly's lighting plant. It glowed brightly for several minutes

DEVICE SIMPLIFIES SIGN LETTERING

SIGN LETTERING of professional finish can be turned out by any amateur, by the use of a new device. Simple tools, somewhat resembling the instruments employed by draftsmen, are used in connection with a light rectangular frame to form guides for making the curves, lines, and angles of which the letters are composed. Various styles of lettering, such as block, outline, and shaded, are possible.

Wonders *of the*

REPRODUCED IN MUSEUM BY

PRESS a button. A motor whirs; a skull nods; a wrist bone turns on a joint; a bony forearm flexes and beckons. A human skeleton bids you come up close and scrutinize the machine that is man.

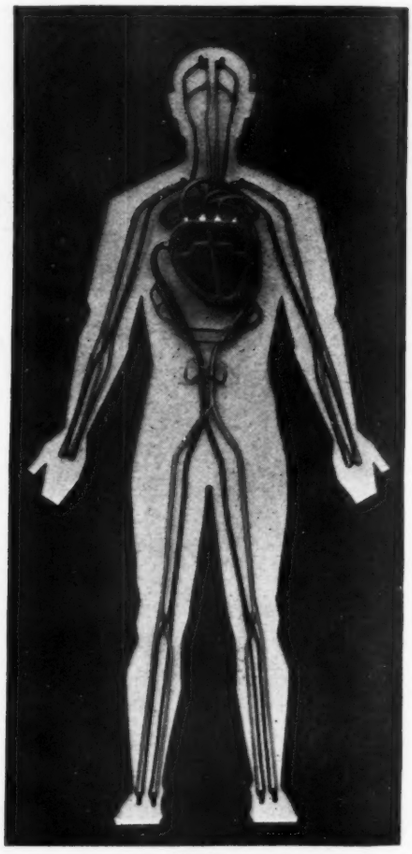
Press another button. A tiny bright light leaves the left half of a mechanical heart, follows a devious course through a mechanical human body, enters the right half of the heart, and goes out. While you watched the light, a blood corpuscle in your own body traveled the selfsame course and in exactly the same length of time—twenty-two seconds.

These are but two of the outstanding exhibits in the new Oliver Cabana, Jr., Hall of Man at the Buffalo Museum of Science, Buffalo, N. Y., a display unique among museum exhibits. The Hall of Man marks what is believed to be the first use of lighting effects and electrically energized movements to exhibit and explain the machine that is man.

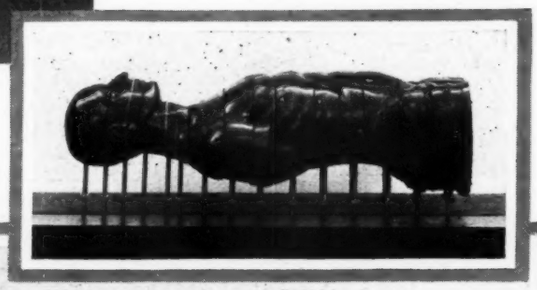
At one end of the hall, in a darkened circular alcove, atop a black pedestal, stands a complete human skeleton wrapped in transparent material. A light flashes on, and the brain is illuminated. Another light flashes; the heart glows. A third light comes on to illuminate the lungs. Every important organ in the human machine is brought to light for visual instruction of the onlookers.

Simultaneously, with *(Continued on page 96)*

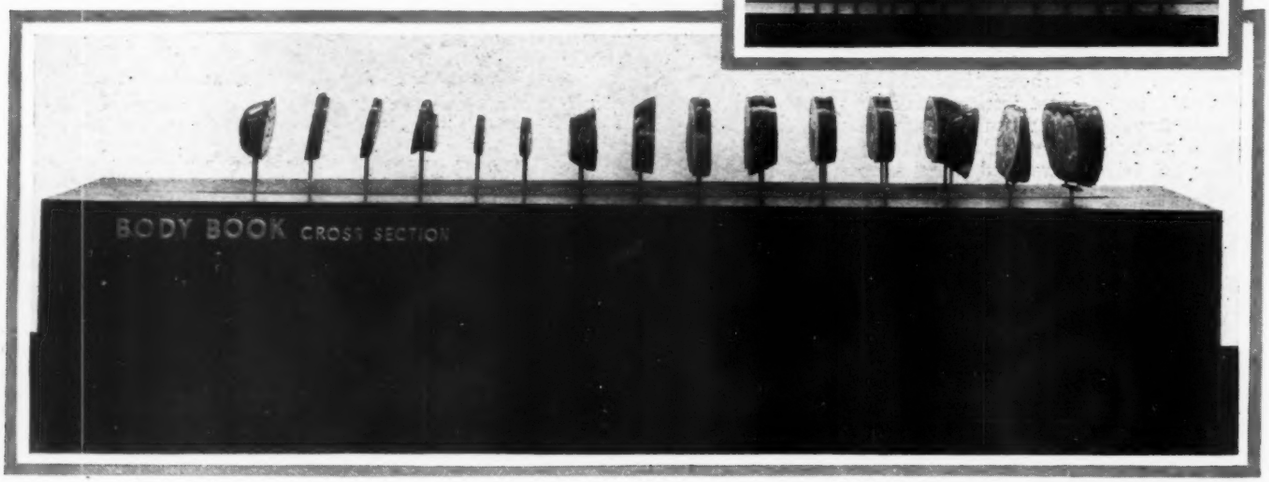
In the exhibit shown at the left, moving lights explain what happens in the brain when we speak, write, hear, and read. Below is the moving skeleton, which turns its head from side to side and beckons with its hand, electrically



In the glass heart of this model, valves are seen working while fluid is pumped through it



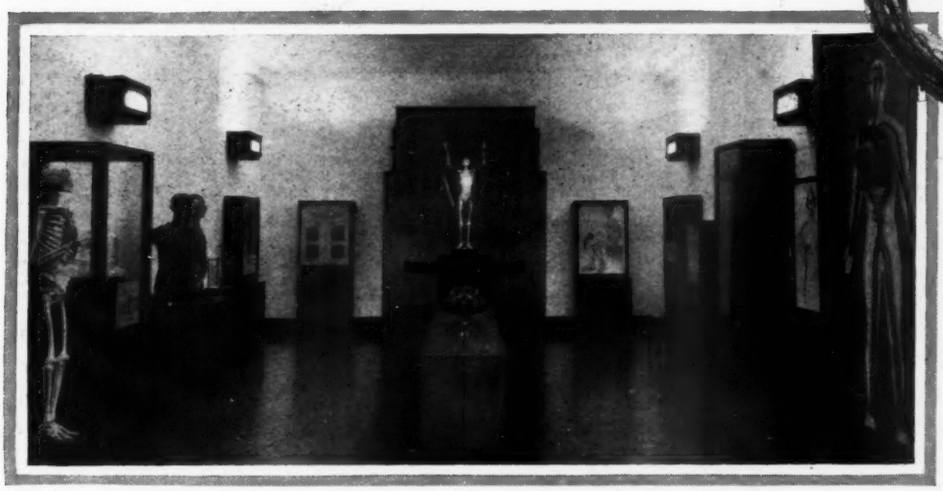
By means of the body book, visitors to the Hall of Man in the Buffalo Museum of Science can take a human body apart, piece by piece. Below is the cross section of the head and torso, with the leaves separated. The insert shows the leaves closed



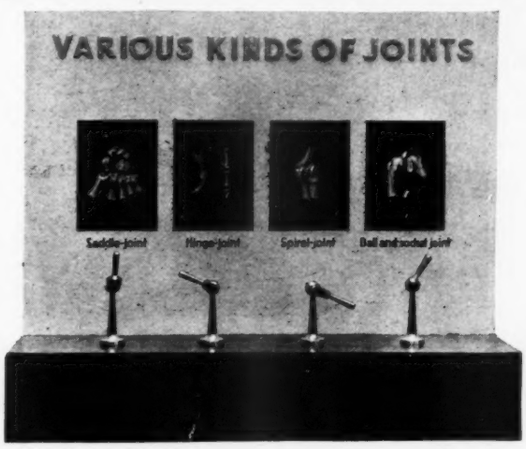
Human Body

MACHINES AND ELECTRICITY

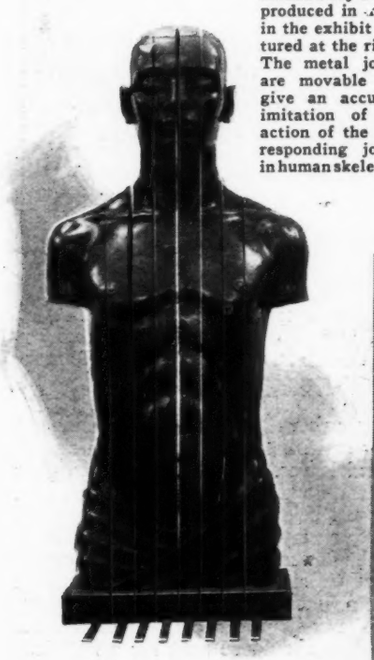
Lights flash on in this transparent figure to indicate the locations of the various important organs of the human body. Labels in its pedestal are lighted simultaneously



A general view of the Hall of Man, a unique feature of the Buffalo Museum of Science in Buffalo, N. Y. In the center background is the transparent human figure in which the organs are successively outlined in light. Many of the other unusual exhibits also can be seen



Four types of joints that occur in the human body are reproduced in metal in the exhibit pictured at the right. The metal joints are movable and give an accurate imitation of the action of the corresponding joints in human skeletons



The vertical section of the body book, a three-dimensional close-up of the human head and torso. When closed, it appears as shown above. In use, the leaves are moved by levers as seen in the picture at the right. The leaves, each two inches thick, are carved and colored to give a realistic representation of the parts of the body occurring at the various sections

A rubber lung, inclosed in a glass case, expands and contracts when a lever in the base is pressed, demonstrating the action of the human lung in breathing

EXPERIMENTS SHOW

How to Keep Flowers Fresh

Simple Methods, Using Plain Water, Prove Most Effective

John W. Vogt, professional florist and originator of the double cyclamen, demonstrates the method of reviving wilted flowers by immersion in cool water. Below, how "bloom tint" is used to change the color of the bloom

The stems of cut flowers should be trimmed under water. When this is done, the stems cannot absorb air before they are placed in the vase

Tests with various supposed chemical preservatives show that plain water is best for keeping flowers fresh, when the proper method is followed

The petals of a flower will change color if an aniline dye is added to the water in the vase, as shown below

Stems of plants having a milky sap can be sealed at the end with a match, as shown in the center picture. For ordinary flowers, use a razor blade and cut on the bias. Woody stems should be split for a half inch from the end. All cutting is done under water for best results

HOW do you preserve flowers after they are cut? Many flower lovers add an aspirin tablet, or some salt, to the water in which flowers are kept. But this practice has no scientific foundation, according to tests made at the Michigan State College of Agriculture and Applied Science.

Blooms wilt, the tests showed, because the stems do not absorb enough water to make up for that which evaporates from petals and leaves. A callosity, formed over the cut end of the stem, impedes the absorption of water.

A simple routine will help to counteract this process. The first rule is to use a very sharp knife, or razor blade, for cutting. Gather the flowers in the early morning or late evening and plunge their stems immediately into water. This protects the stems until they can be placed in vases.

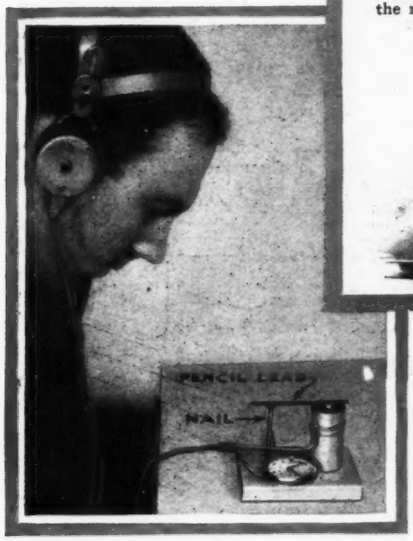
The stems of ordinary flowers should be cut on the bias, while woody stems should be split for a half inch from the end. Stems having a milky sap, such as those of poppies, should be heated at the ends with a match or boiling water to coagulate the sap and form a seal that forces the blooms to suck water through the stem walls.

Change the water in your vases daily and at the same time trim off a thin slice from the ends of the stems. This trimming should be done under water. When arranging your vases, keep them out of sunlight and drafts.

The color of blooms can be changed, if desired, by adding a harmless aniline dye to the water in the vase, or by placing "bloom tint" in a bag with the flower and shaking it.

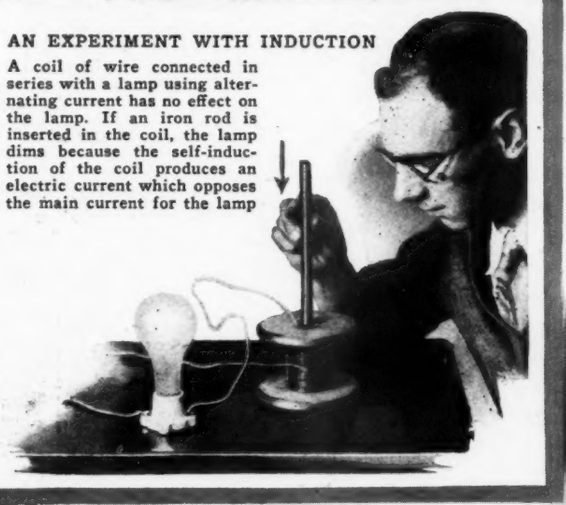
Home Tests FOR THE AMATEUR Scientist

A SIMPLE MICROPHONE. Headphone cords are connected to a nail and to the metal case of a flashlight cell. A pencil lead is laid across the nail and the center post of the cell. When you listen through the headphones, the ticking of a watch sounds like loud claps of thunder

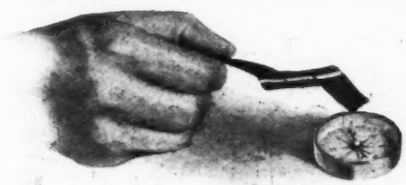


AN EXPERIMENT WITH INDUCTION

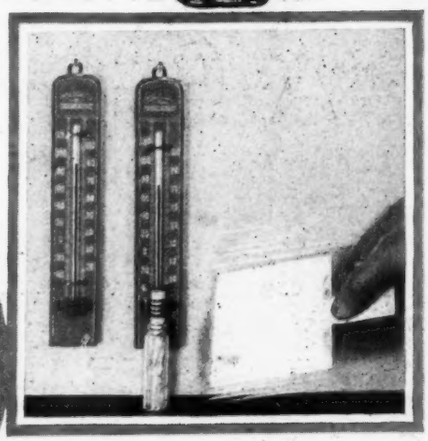
A coil of wire connected in series with a lamp using alternating current has no effect on the lamp. If an iron rod is inserted in the coil, the lamp dims because the self-induction of the coil produces an electric current which opposes the main current for the lamp



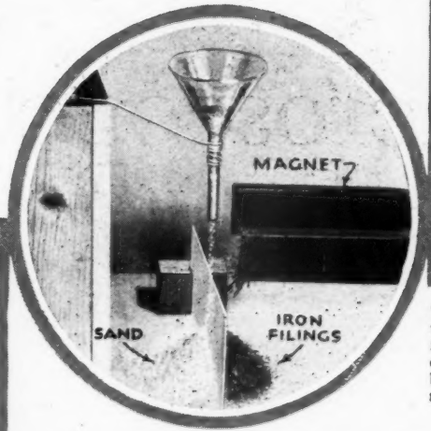
HEAT INSULATION. Water is so poor a conductor of heat that when a little gasoline is ignited on the water in the funnel, the air in the medicine-dropper bulb is not expanded enough to force air bubbles through the water in the large bottle below



MAGNETIZING METAL. Twisting a small piece of metal makes it a magnet, as can be proved with a magnetic compass. Each end will attract a different pole of the needle

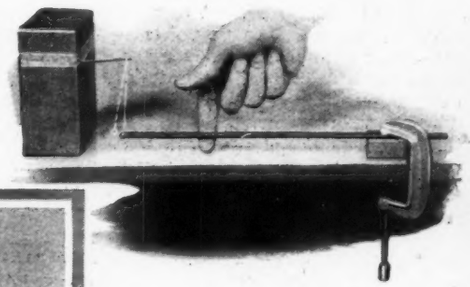


TEST FOR HUMIDITY. Place a moist wick on the bulb of a thermometer and fan it. The reading will be lower than that of another thermometer, because of evaporation. The difference will be less when humidity is high, since the air cannot absorb so much moisture then from the wick

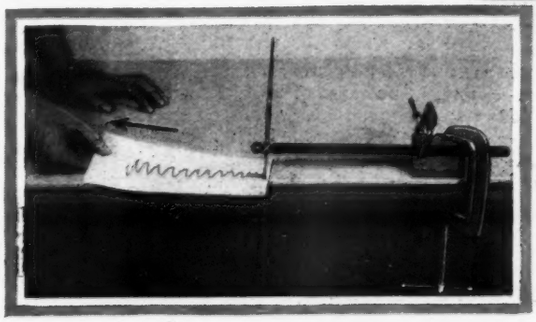


MAGNETIC SEPARATOR. Allow a mixture of fine iron filings and sand to fall from a funnel across the poles of a permanent magnet. The metallic particles are drawn to one side of the partition, while the unattracted sand falls on the other

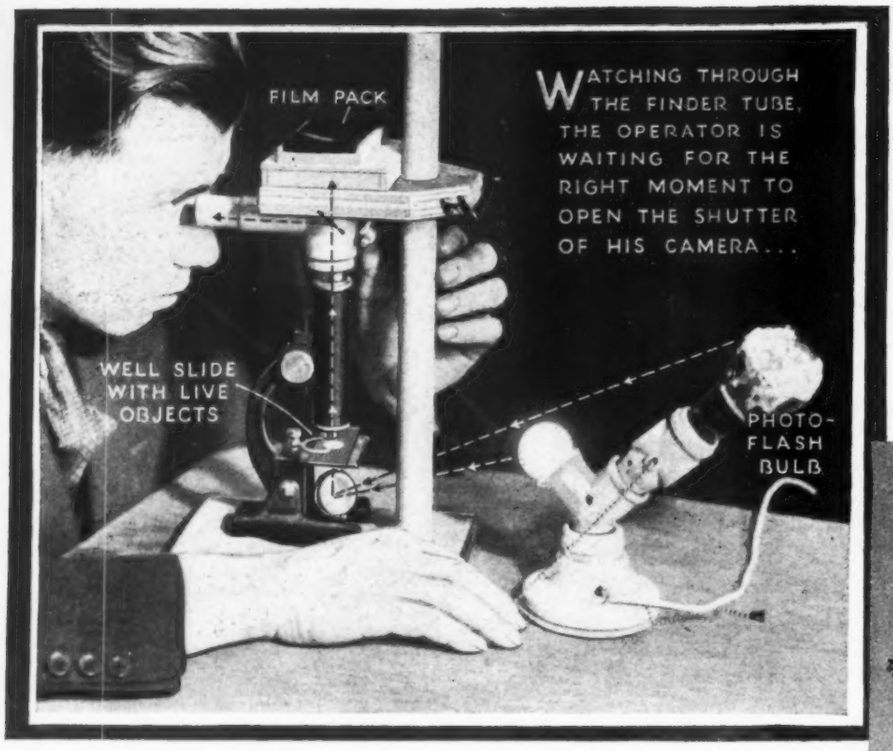
REFRACTION OF LIGHT. When rays from a flash light pass through a slit in a card into a mixture of water and talcum powder, the beam is bent at the surface, because of the difference in refractive index for air and water

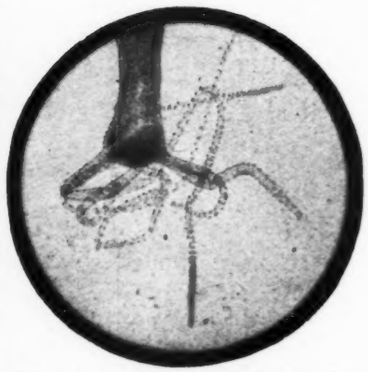


LONGITUDINAL VIBRATIONS. That a rod vibrating from side to side also vibrates from end to end, can be shown by suspending a small lead ball in contact with the end of the rod. As the rod vibrates, the ball will swing longitudinally



VIBRATION WAVE. A vibrating body, like the hack-saw blade at the right, will write the story of its vibration with an attached inked brush. The blade is set vibrating with the finger, and the paper is drawn under the brush


FILM PACK
WATCHING THROUGH THE FINDER TUBE, THE OPERATOR IS WAITING FOR THE RIGHT MOMENT TO OPEN THE SHUTTER OF HIS CAMERA...
WELL SLIDE WITH LIVE OBJECTS
PHOTO-FLASH BULB



Using the camera described here, the author made this photomicrograph of a *hydra viridis* with his own microscope

A Camera for Your Microscope

THAT'S EASY TO MAKE

PART of the pleasure of owning a microscope is the thrill of showmanship.

Suppose, for instance, that you are exploring the microscopic jungle of green algae in a drop of stagnant pond water, and you catch sight of a particularly interesting group of vorticellae, or bell-flower animalcules. They are as beautiful as a bed of microscopic tulips, and their movements, as they bob up and down on their springlike stems, are so interesting that you long for a friend to share the wonderful sight with you.

Such discoveries, however, are all too frequently made when the audience is absent. If you wish to exhibit them, you must resort to photography, which will fix the spectacle permanently on paper. Besides, you can in this way gradually build up an album of microscopic "animal pictures," taken in the invisible, water world which will be of increasing interest and beauty as you add to your successes in photomicrography.

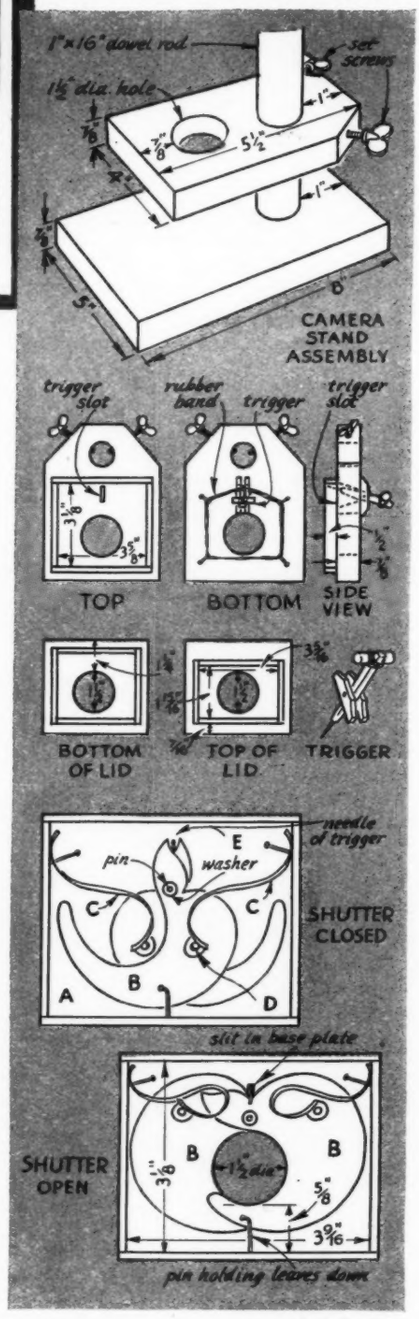
But living creatures move, and even in a drop of water they often move rapidly. How can you catch the fleeting picture—the second of relative stillness when a tiny creature is poised, perhaps, upon a green thread of microscopic plant?

To do this, you must first devise a form of camera which will enable you to observe your infinitesimal subject up to, and during, the second when the picture is taken and then provide some means of creating a flash of brilliant light with which to take the picture when the little creature is momentarily quiet.

A photoflash bulb will, of course, furnish the flash of light needed. In the case of the moving pictures, to be described later, a photoflood lamp will be used instead.

Since the essential thing you need in taking photomicrographs of living subjects is a camera of the reflex type, which permits you to view the image until the instant the picture is taken, let us see how you can construct one on a miniature scale.

This can be done easily by the use of an ordinary round, one-inch cover glass, such as is used to cover a specimen on a slide. When one of these paper-thin disks of crystal is mounted at an angle of forty-



Drawings above show details of camera stand, trigger mechanism, and shutter. Patterns for shutter blades and spring are given elsewhere

Build This Simple Apparatus and Keep a Photographic Record of the Interesting Things You Discover

By GAYLORD JOHNSON

five degrees in a cardboard tube, as shown in the diagram on this page, it allows most of the light coming through the microscope eyepiece to pass straight through to a ground-glass screen on which you can view the magnified image. The cover glass is too thin to distort this image, as a thicker glass would do. Enough light, however, is reflected from the surface of the cover glass so that a part of the rays are deflected into a focusing tube *(G)*, set at right angles and onto a smaller ground glass which makes a second image visible through the focusing tube *(J)*. It creates a sort of periscope, enabling you to see into and down the microscope tube and to view the identical image which is projected on the large ground-glass screen.

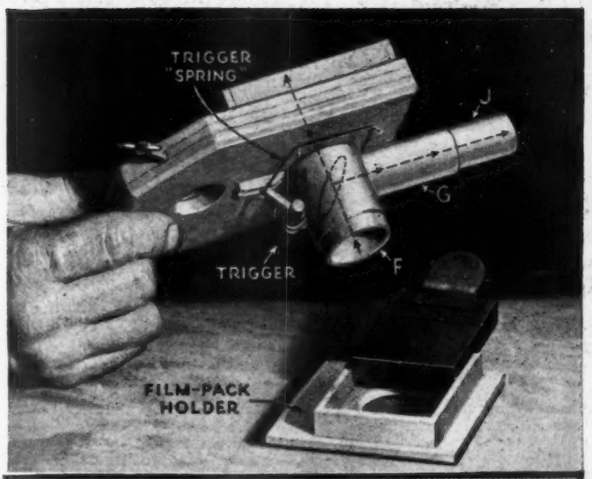
The only precaution needed in adjusting the position of the ground glass in the focusing tube is to place it so that the distance from the center of the cover-glass reflector to each of the ground-glass screens is the same.

You need not, however, measure these distances. Simply mount the smaller ground-glass screen in the end of a tube *(J)* which slides inside of the main focusing tube *(G)*. Then, when the completed camera is placed on its stand over the microscope, it is easy to focus the image of an object sharply on the larger ground-glass screen and push the sliding inner tube *(J)* in or out until the image upon its ground glass is also perfectly sharp. After this focus is once determined, the inner tube can be glued firmly in place.

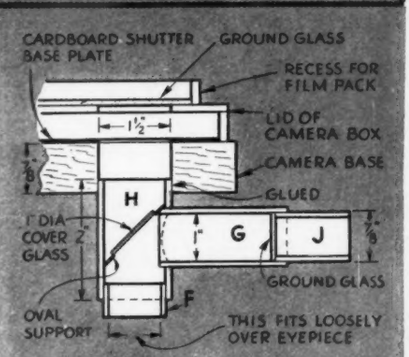
The tubes are easily made by moistening and rolling up ordinary gummed two-inch, package-sealing tape. The small, round screen can be cut from a sheet of the frosted celluloid sold at camera stores, from a bit of architect's tracing cloth, or a sheet of oiled writing paper. The scale plan shows the dimensions of the two tubes, which are fixed at right angles.

The next step is to construct a recess to hold an ordinary film pack of the vest-pocket size one and five eighths by two and three eighths inches, and some sort of shutter which can be opened and held open by the finger, yet will automatically close when its trigger is released.

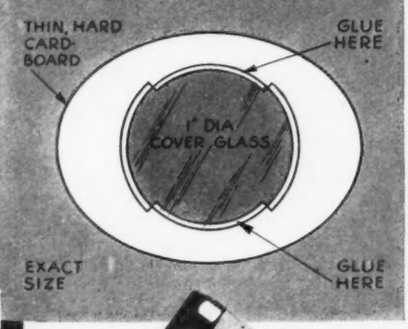
The scale plans on the opposite page, and the actual-size patterns given elsewhere will enable you to build the camera box and shutter from common materials. The base plate *(A)* and the shutter blades *(B)* should be cut from fiber cardboard having the smoothest possible sur- *(Continued on page 86)*

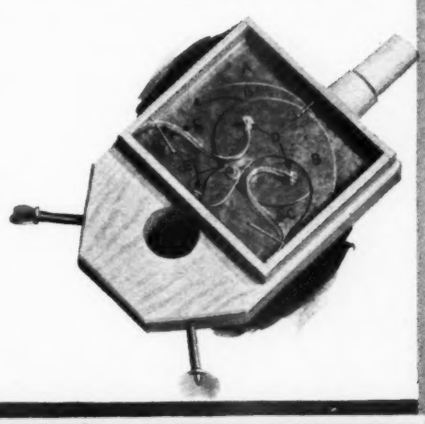


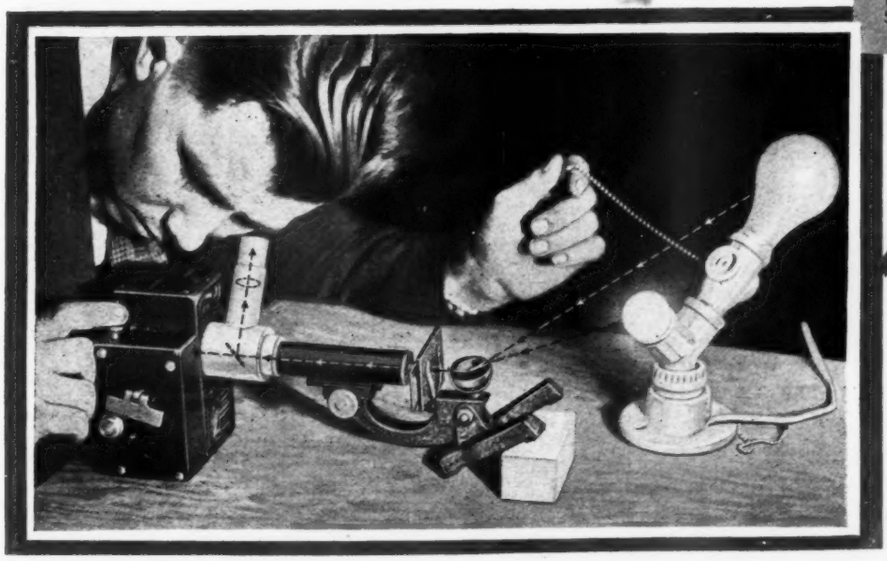
This photo-diagram illustrates the action of the slanting cover glass in allowing light from the microscope to pass through to the film pack, while also reflecting an image to the viewing tube

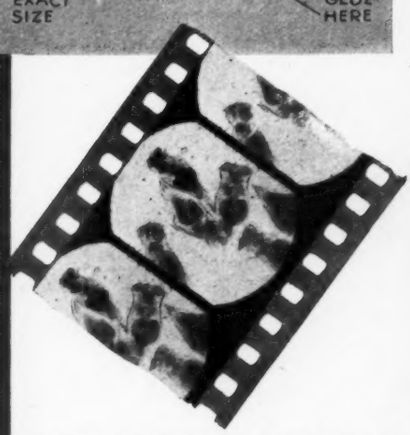


Construction of camera base and tubes. The camera base and shutter mechanism are shown at left. Below, how cover glass is mounted to serve as reflector for focusing tube









HOW MICROSCOPE MOVIES ARE MADE

With the finder tube, microscope, and lights arranged as at the left, you can take movies with an ordinary amateur movie camera, using a photoflood bulb for illumination. The film strip above was made by the author

HOUSEHOLD TASKS MADE

New Appliances

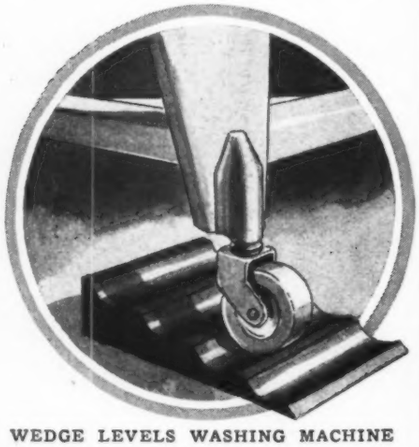
SELF-CONTAINED TELEPHONE. Because its bell box is built into the cradle of the French-style receiver-transmitter, this new telephone can be installed without marring furniture or walls. The additional weight given the base by this arrangement is really an advantage, as it keeps the base from slipping when a number is being called by means of the dial

MILK-BOTTLE TOP HAS GRAVITY LID

Operated by a weight like the eyes of a doll, the lid of this new sanitary milk-bottle top lifts itself when the bottle is tilted to pour milk into a glass or a dish. The curved lip makes it easy to pour without spilling

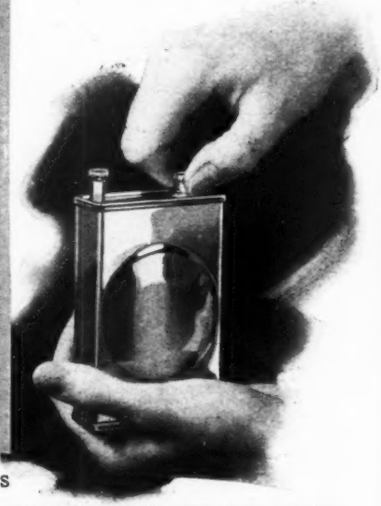
HOLDS COAT HANGER ON LINE

Garments on coat hangers can be left hanging on clotheslines without danger of their slipping or being blown off by the wind, when this handy clip is used. It grips the line securely



WEDGE LEVELS WASHING MACHINE

Placed under the leg of a washing machine, this rubber wedge makes up for any unevenness in the floor and also dampens vibration. Its upper, slanting surface is corrugated to fit either a plain rounded foot or a rubber-tired caster

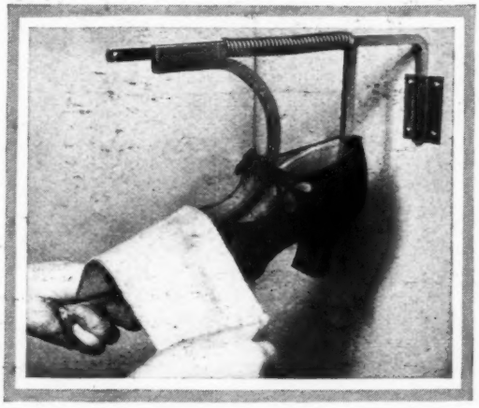


NEW METHOD FOR CLEANING GLASS

A novel dispenser is supplied with a new preparation for cleaning glass. A valve screw is turned and the liquid is squirted on the glass by squeezing the sides of the container. The glass can then be polished by rubbing briskly with a cloth

SHOE-SHINING RACK

Especially convenient for cleaning sport shoes, the shoe-shining outfit illustrated has a spring-operated arm that adjusts heel and toe pieces automatically



CAP PROTECTS PERCOLATOR TOP

Resembling a chimney cap, this shield fits on the inner spout of a percolator and prevents the boiling liquid from striking the glass top and breaking it. The cap is installed simply by slipping it over the end of the tube

LIGHTER THROUGH

for the Home

ELECTRIC PUMP HAS SAFETY FEATURE

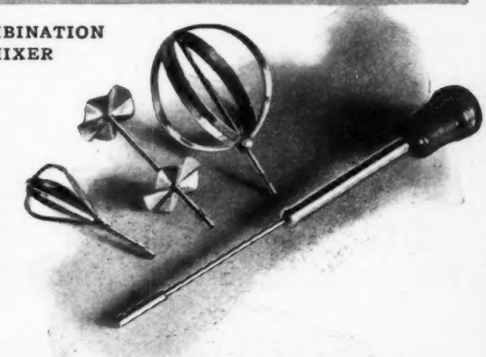
Children can play in perfect safety around the electric water pump illustrated above. It has only one moving part, a turbinelike impeller which is completely covered. Water is pumped to either tank or faucets

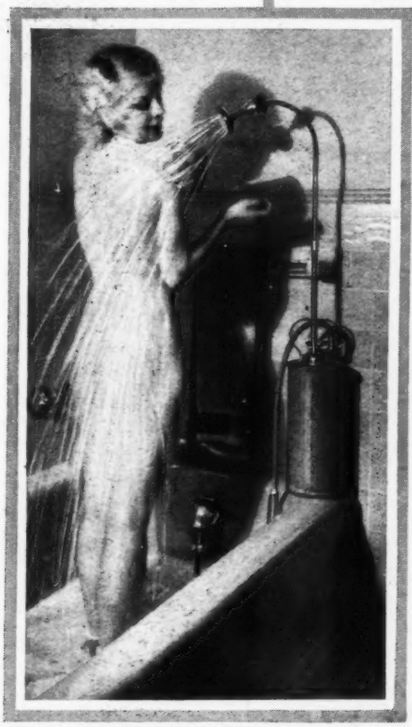
NOVEL YARN HOLDER

Knitting yarn is kept fresh and clean by the unusual holder at the right, and is drawn easily through a hole in the upper half of the globe. Base is weighted

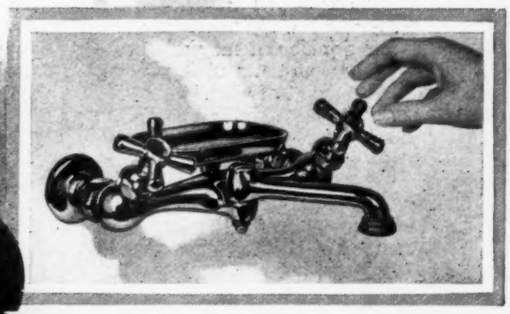
MANY-PURPOSE COMBINATION BEATER AND MIXER

A spiral plunger action operates this combination beater and mixer. Three separate attachments adapt it for use in beating eggs, mixing cocktails and other beverages, and stirring chocolate or malted-milk drinks. The picture above shows it in use; at right, the handle and its three attachments





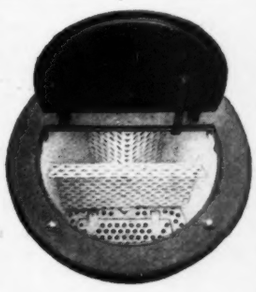
SHOWER SOFTENS WATER. A shower attachment and water softener are combined in this portable unit. Several other special attachments adapt the water softener to other domestic uses



SLANTING FAUCET HANDLES. The latest thing in sink faucets has handles that meet the housewife half way by slanting outward at an angle of forty-five degrees from the perpendicular. The jaunty angle gives a novel appearance, as well as greater convenience in use

RUBBISH IS FUEL FOR INCINERATOR

The new sanitary incinerator pictured at the left has two compartments, one at the bottom for rubbish that will burn easily and one at the top for damp, organic waste. The rubbish is ignited and the hot gases pass through the less combustible material, drying it so it will burn



HOME-LABORATORY EXPERIMENTS REVEAL

Strange Facts *about* Water

Steam That Chars Paper, and Water That Boils Under 212 Degrees, Are Among the Curiosities You Can Demonstrate Easily

By RAYMOND B. WAILES

You can light a cigarette as readily with a jet of superheated steam as with a match. The photograph at the left shows how to set up a simple generator for heating the steam

WHEN you pour yourself a glass of water, do you assume that the water is pure? With no reflection on its fitness for drinking, it may and probably does contain all sorts of impurities, from a chemical point of view. One of the most outstanding properties of water is the variety of substances that it dissolves, and consequently almost all water contains foreign solids, and gases such as air and carbon dioxide, in solution. Even glass dissolves in water—not very readily, to be sure, but enough to enable you to prove it by a simple test.

Place some fragments of glass in a mortar and moisten them with several drops of water. Grind the wet glass to a paste. Now add a drop or two of phenolphthalein solution. A pink color appears, indicating that the glass has dissolved and yielded alkaline ions to the water. The test shows that a drinking glass actually becomes a little thinner each time you use it, as a minute amount of the glass dissolves in each glassful of water.

Falling rain absorbs carbon dioxide, ammonia, and sulphur compounds from the air, reaching the earth not as pure water but as a true solution. Seeping underground, water dissolves mineral matter. When the water is later used for domestic purposes, these minerals may make trouble of various kinds for the consumer.

Iron and manganese in the water may stop up pipes, and discolor clothing in laundering. Acidity in the water is likely to corrode the supply system. Calcium and magnesium compounds require an excessive amount of soap to be used for washing purposes. In industrial establishments where steam is generated, mineral matter in water crystallizes and forms a heat-insulating layer between the source of the heat and the water, hindering the operation of boilers.

In your home laboratory, you can readily compare water from different sources and determine, with a little chemical detective work, which is best for laundering. Hard water, containing relatively large amounts of calcium and magnesium, is the least desirable; soap will do its work only after a considerable portion of it has combined chemically with these minerals and removed them, forming a messy curd or precipitate. For practical purposes, that much soap has been wasted.

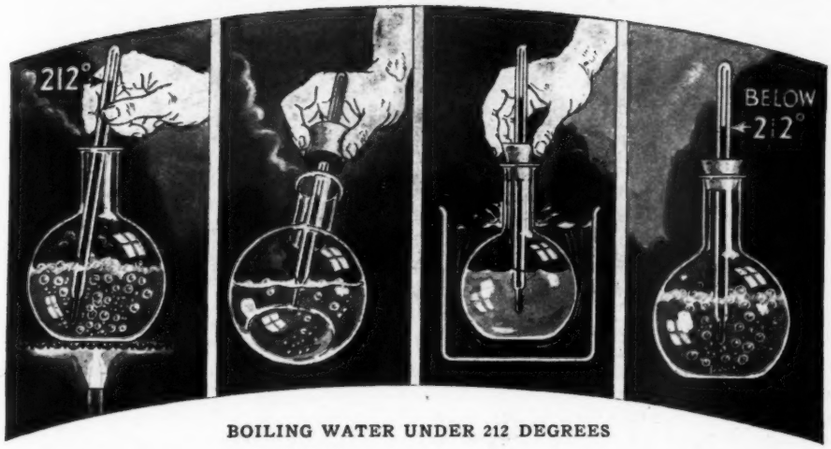
To test the hardness of water, dissolve about half a cubic inch of soap—preferably Castile soap—in about 100 cubic centimeters of alcohol (an eight-ounce drinking glass holds about 240 cubic centimeters). Ordinary denatured alcohol is perfectly suitable for this experiment. The soap will dissolve more rapidly if the mixture is kept in a warm place, a day or two being required if it is cold.

When this alcoholic soap solution has been prepared, filter it and measure off ten cubic centimeters, diluting this portion to about 100 cubic centimeters with plain denatured alcohol. The resulting soap solution will be of the right strength for your tests.

Place fifty cubic centimeters of the water to be tested in a flat-sided bottle and add some of the soap solution, a few drops at a time, from a burette. Shake the bottle after each addition. The process is repeated until a foam or lather is formed and remains unbroken on the surface of the water for about five minutes. By noting the burette readings at the start and finish of the test, you know how much soap solution was required to off-

How Hard Is Hard Water?

To test the "hardness" of water from your home supply, add a soap solution, a drop at a time, to a sample of the water in a bottle. Shake the bottle frequently. The burette will show how much soap is needed to form a permanent lather



BOILING WATER UNDER 212 DEGREES

1 Boil some water in an uncorked flask and note temperature

2 Remove flask from heat and insert a cork and thermometer

3 Dip flask carefully in cold water and swirl contents around

4 Water in flask boils again, at less than 212 degrees

set the minerals in the water, and this permits you to gauge the relative hardness of the water. If fifty cubic centimeters of water from another source, for example, require twice as much soap solution, then the second sample of water is twice as hard as the first. Freshly boiled and cooled distilled water, which will be about the purest you can obtain, will need only about a half of a cubic centimeter of the soap solution to form the lather. If you want to make your own hard water, for comparison, you can do it artifically by dissolving a speck or two of plaster of Paris, calcium chloride, or Epsom salts in the sample.

Iron in water may be detected by evaporating fifty or 100 cubic centimeters of water down to about half a cubic centimeter, and then adding a drop or two of strong hydrochloric acid. A yellow color formed at this point may be due to iron. Now add a drop of nitric acid and then a drop or two of sodium or ammonium thiocyanate, or sulphocyanide. If a red color is formed, it is a sure sign that the water under test contains iron.

A drop of silver nitrate solution, added to ten or fifteen cubic centimeters of water which has been acidified by a drop or two of nitric acid, will yield a white precipitate of silver chloride if the water contains any chlorides, such as common salt.

You can detect calcium in water by adding in turn a drop or two of ammonium chloride solution, a drop of ammonium hydroxide, and a drop of ammonium oxalate solution. A white precipitate is probably calcium oxalate, showing the presence of calcium.

TESTING for magnesium is a little more difficult, but you can do it by filtering the liquid from the previous test, to remove the white precipitate, and adding a solution of ammonium phosphate to the clear liquid remaining. If a white precipitate is formed, it is probably ammonium-magnesium phosphate, which shows the presence of magnesium in the original sample. Sometimes the precipitate is reluctant to form, and the process can be aided by rubbing the inside of the test tube with a glass rod.

The physical properties of water, no less than its chemical properties, afford interesting home experiments. At the atmospheric pressure of sea level, water boils, turning to steam, at 212 degrees Fahrenheit or 100 degrees Centigrade. Contrary to popular belief, water boiling vigorously is no hotter than water that is just simmering. Boil water violently in one beaker, and keep another beakerful just at the stage of forming steam bubbles; thermometers placed in the two beakers will register exactly the same.

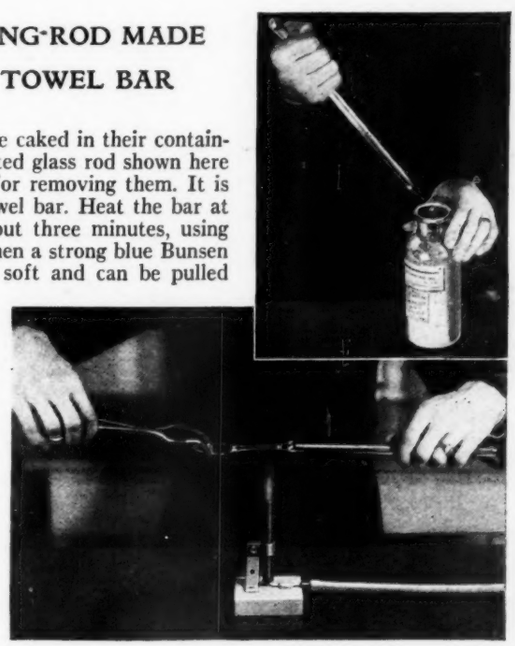
Raising or lowering the surrounding pressure, however, does alter the temperature at which water boils. If a flask of water were stoppered with a thermometer dipping into the liquid inside, and the water were boiled, the thermometer would show a rise of temperature well above 212 degrees Fahrenheit because of the pressure of the confined steam. Since the steam pressure would soon burst the flask, no one should attempt this experiment.

If the pressure within the flask is reduced, on the other hand, the boiling temperature of water is lowered, and this experiment is safe and easy to perform. First boil some water in an uncorked flask. Remove the flask from the heat and stopper it with a cork carrying a thermometer. Dip the flask cautiously into cool water, swirling its contents to distribute the heat evenly so that the glass will not crack. You will see the water in the flask boil again, and a look at the thermometer shows that its temperature is lower than the usual boiling point.

As you have seen, water at sea-level atmospheric pressure cannot be made hotter than 212 degrees Fahrenheit, the point at which it boils and turns to steam. This does not imply, however, that the vapor, or steam, cannot be made still hotter. As a matter of fact, it can be heated much more, and is then known as superheated steam. You can use it in a number of striking experiments.

TO MAKE superheated steam from ordinary or "wet" steam, a flask is fitted with a one-hole cork through which passes an L-shaped tube of glass or metal. A piece of wire screen on a ring clamped to a ring stand or other laboratory support may serve as a rest for the flask. When water has been added to the flask, heat is applied with a Bunsen burner or alcohol lamp. The steam thus generated is now superheated by leading it through a heated coil of copper tubing, wound from two or three feet of small tubing and connected to the steam generator with about an inch of rubber tubing. The copper-coil superheater is placed horizontally and heated as hot as possible; an ordinary Bunsen burner may be used, although a burner of the *(Continued on page 97)*

USEFUL STIRRING-ROD MADE FROM GLASS TOWEL BAR



WHEN chemicals have caked in their containers, the heavy, pointed glass rod shown here makes an excellent tool for removing them. It is made from a ten-cent towel bar. Heat the bar at the desired point for about three minutes, using first a yellow flame and then a strong blue Bunsen flame. The rod becomes soft and can be pulled apart like taffy. Shape the point with forceps or pliers and cool the bar slowly by gradually lowering the flame, ending with a yellow flame and rotating the bar continuously. The opposite end may be rounded in the same manner. Since the rod is made of glass, it will not react with or contaminate the chemicals with which it comes into contact.

BUILD THIS LIGHT, COMPACT Portable Short

By J. B. CARTER

ALTHOUGH novelty, in itself, is no criterion for receiver efficiency, it becomes significant when the novelty results in better performance. Basically, the circuit of the compact short-wave receiver illustrated is a straightforward, trustworthy, two-tube set, consisting of a regenerative detector and one stage of transformer-coupled, audio amplification. Physically, however, it embodies several brand-new ideas that make for compactness, less weight, and easier operation.

First of all, since the filaments of the two type '30 tubes are connected in series with an eight-ohm resistor, a single, large-size 4½-volt "C" battery can be used as the "A" supply. With the total current drain for the filaments totaling only sixty milliamperes, this battery will last for five or six weeks.

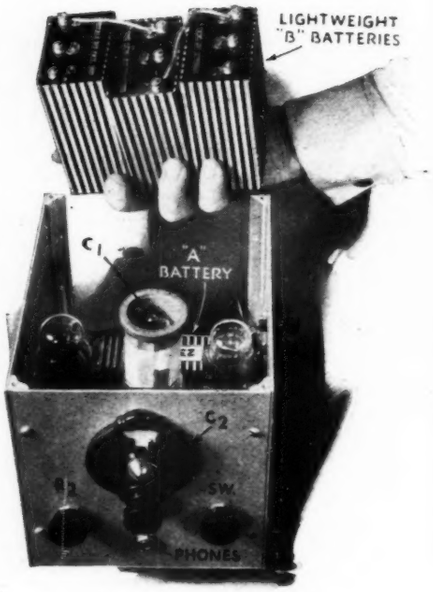
Plate voltage, on the other hand, is supplied by three of the new-type portable forty-five volt "B" batteries. These batteries are very small in size, measuring approximately two by three and one half by four and one half inches, but, in spite of their tiny proportions, will last six months on the basis of about four hours use a day. Because of the compact design of the aluminum cabinet, the entire battery supply fits snugly into one end and requires no braces or hooks to hold it in place.

When we analyze the actual photographs of the circuit, the first physical feature to attract attention is the location and use of the antenna trimmer condenser C_1. Usually, this condenser is a single "postage-stamp" unit placed close to the antenna binding post. In this circuit, however, each plug-in coil is fitted with an individual miniature variable condenser. Although this arrangement requires the use of a special coil form, provided with a threaded shelf to take the condenser, and several condensers, the advantages gained more than offset the cost. Since each plug-in coil has its own trimmer, once the correct condenser setting has been found for each coil, no further adjustment is necessary, providing the antenna length is not altered. As each coil is plugged into the circuit the correct trimmer capacity automatically is provided.

If the cost of the receiver runs too high with these multi-trimmers included, they can be omitted. A single three-plate midget condenser, insulated with the suitable washers and mounted on the side of the aluminum case, can be used instead.

Besides being light in weight, the inexpensive aluminum cabinet also serves as a perfect shield for the receiver. Provision to simplify the changing of coils is provided in the form of a hole cut in the top of the case and fitted with a snug aluminum lid to exclude dirt and dust.

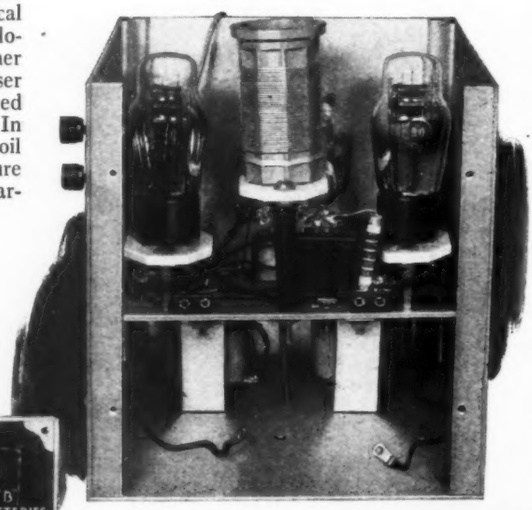
Tuning is accomplished by means of a small .00014-mfd. variable condenser (C_2) shunted across the grid winding or secondary (L_2) of the plug-in coil. The primary winding (L_1) is interwound with the secondary and the tickler (L_3) is a small winding placed near the base of the coil. For those who wish to buy the bare forms and wind their own coils, the necessary winding data is given in convenient table form elsewhere in this article.

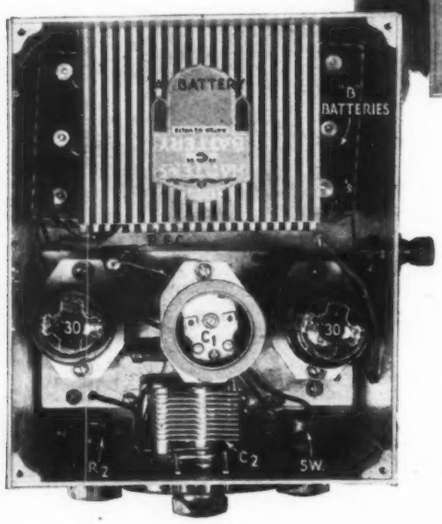


This view shows the front of the cabinet with the top removed. The size of the new, small "B" batteries is seen by comparison with the hand

The use of an audio-output transformer (T_2) adds immensely to the efficiency of this little set, permitting high plate voltage on the audio amplifier and thus increasing the amplification of the received signal to an amazing extent. Furthermore, it keeps direct current out of the headphones and eliminates the effects of body capacity.

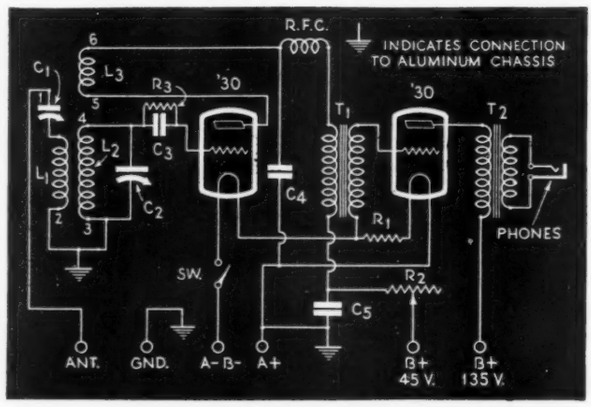
The adjustment of the receiver is about as simple as its construction. First, rotate the regeneration control (R_2) slowly until a rushing sound is heard in the phones. When this control is advanced too far, a distinct "plop" will be heard, signifying that the detector tube is oscillating. If no "plop" is heard, check over all the connections. A common trouble is a reversed tickler winding. Trace connections through the prongs to the socket and make sure that all leads are poled properly.





Above is a rear view of the set with the top, back, and batteries removed. Note supports for sockets

Positions of parts and batteries can be seen in the picture at the left, taken from above with top off



Schematic diagram at right shows the wiring of the circuit

-Wave Receiver

For the next step in the adjustment, attempt to tune in a signal by rotating the tuning dial slowly. If the receiver is oscillating, a squeal will be heard in the phones. To remove the squeal, retard the regeneration control and retune the condenser C_2.

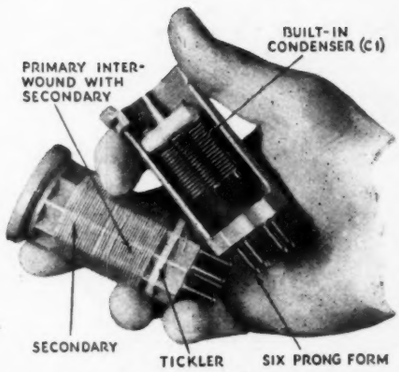
At this point, adjust the antenna condenser C_1 for maximum response. This may cause the receiver to break into oscillation. If it does, retune the main condenser C_2. This process should be repeated until a main condenser setting is obtained that will allow the antenna condenser to be rotated over its full range without bringing the receiver into oscillation. When this point has been reached, the antenna condenser should be retuned for maximum signal strength and left in that position.

This process then should be repeated for each of the four plug-in coils. If care is taken in making the adjustments, it will be unnecessary to touch the trimmers again, provided, of course, the length and location of the antenna and lead-in are not changed.

Incidentally, this built-in condenser arrangement can be used for band spreading instead of antenna trimming if desired. The condenser in each plug-in coil is simply so wired that it will be connected in parallel with (across) the main tuning condenser (P.S.M., Oct. '34, p. 64) instead of into the antenna lead to the primary winding. If this is done, it will be necessary, of course, to provide a separate antenna-trimmer unit of the usual type.

If the receiver is to be used for portable work, an inexpensive leather or metal handle, obtainable at your neighborhood hardware store, can be attached easily to the top of the case with two screws. Also, if desired, a neat and convenient canvas carrying case can be made to house the entire cabinet.

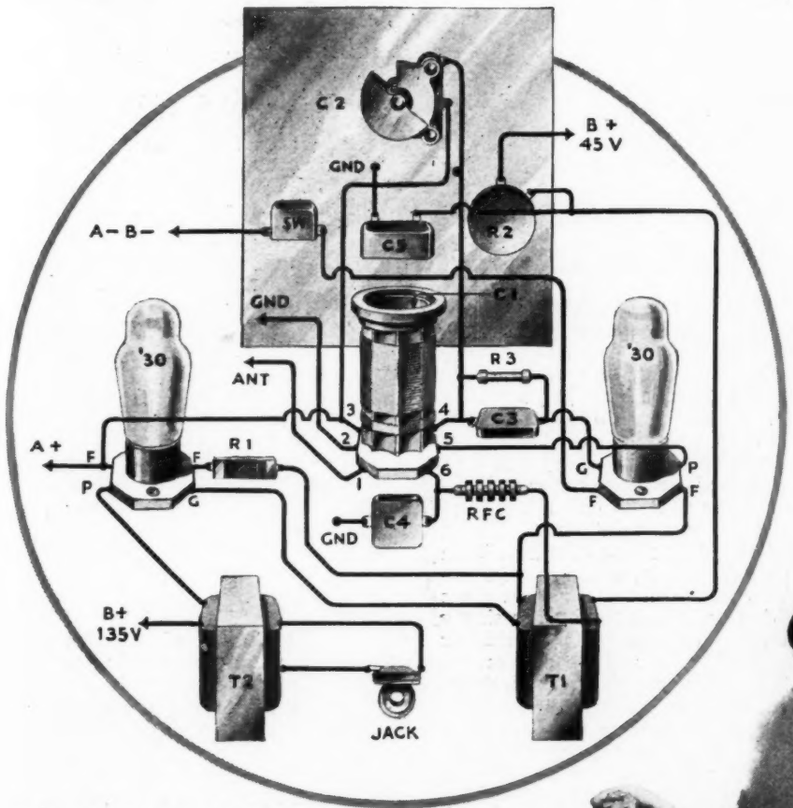
Since it is completely self-contained and thoroughly shielded, this little circuit also can serve as a reliable monitor for an amateur transmitting station. It can be calibrated by using it first as a regular receiver and spotting various marker stations on the band desired.



A complete plug-in coil, and one cut away to show the built-in variable trimmer condenser

LIST OF PARTS

C_1.—Variable trimmer condenser, one for each plug-in coil, 50 mmfd.
C_2.—Variable condenser, 140 mmfd.
R_1.—Resistor, 8 ohm
R_2.—Variable resistor, 50,000 ohm
R_3.—Carbon grid leak, 5 meg.
T_1.—Transformer, 1 to 4 step-up
T_2.—Output transformer
R. F. C. Choke, 10 mh.
Aluminum case, chassis, and coil cover
Set of six-prong plug-in coils (four)
Single pole switch
45-volt portable "B" batteries (three)
4½-volt "C" battery



Relative positions of the various parts, as well as the wiring of the circuit, are made clear by this picture diagram. Compare with diagram on opposite page

Changing of coils is made easy by a hole cut in the top of the case and fitted with a dustproof lid

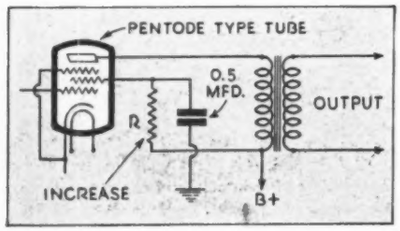
HOW TO WIND THE COILS

Coil Range Meters	Primary Turns	Tickler Turns	Secondary Turns
17-41	5.8	3.8	8.7—No. 16 enam., 7 to in.
33-75	11.8	5.8	17.7—No. 16 enam., 12 to in.
66-150	24.8	10.8	37.7—No. 24 enam., 24 to in.
135-270	47.8	16.8	81.7—No. 28 enam., 44 to in.

NOTE: Primaries wound with No. 34 dsc. wire. Ticklers wound with No. 32 dsc. wire. Primary windings interwound with secondary starting at ground end and have same number turns per inch as secondaries. All coils wound in same direction.

TIMELY TIPS ON

Radio Building and Repair

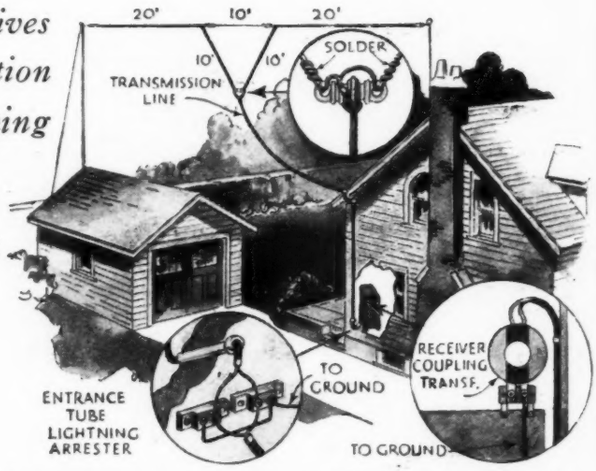


For Better Tube Output

MANY radio receivers using pentode tubes in the output stages have a tendency to be somewhat sluggish on low notes, and at the same time exhibit troublesome hum amplification. These faults often can be corrected simply by increasing the screen-grid resistance (R) to about double its original value (or by inserting a 5,000-ohm resistance if there is no such unit) and then bypassing the resistance to ground through a 0.5-mfd. condenser, as illustrated. No changes need be made in any of the other constants of the circuit, including the "B"-supply voltage.—E.B.L.

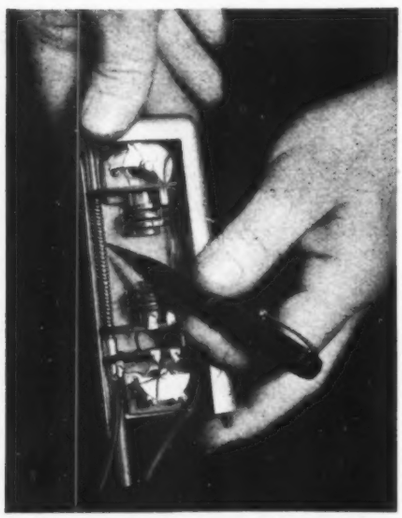
New Antenna Gives All-Wave Reception Without Switching

FOR all-wave reception, the latest thing in antennas is the "V-doublet." According to its manufacturer, it not only provides uniform sensitivity on the short-wave bands, but retains this efficiency on the broadcast frequencies without the necessity for any sort of mechanical switching at the receiver-coupling transformer. It derives its name of "V-doublet" from the unique V-shaped center portion between the antenna proper and the transmission line. The antenna requires only two points of suspension, and comes complete in kit form including the necessary insulators, lead-in, and special receiver-coupling transformer. Overall, the main antenna measures only fifty feet from insulator to insulator, a convenient size for almost any installation. For best results, the system should be rigged as high as possible.



Layout of new antenna which gives uniform sensitivity on all bands

I-F Transformer Has Variable Coupling



Sliding spring action gives variable coupling

SOMETHING radically new is provided by this intermediate-frequency coupling unit made up of two sets of bank-wound low-loss coils, each tuned by its own variable condenser to the proper frequency. Unlike the usual I-F transformers, the coupling between the two coils is made continuously variable by means of an ingenious sliding spring action and provision is made either to lock this slide at the most favorable point or to make it variable at will by means of a cam. With such an arrangement, variations of coupling from one third to over three times the critical value may be obtained simply by turning a dial mounted on the receiver panel. Both coils and condensers are mounted within an aluminum shield, shown here cut away to illustrate the positions of the various components. These transformers may be used in connection with any screen grid tubes such as are normally used for intermediate-frequency amplifiers.

Vinegar "vulcanizes" rubber cement on bare wire

Covering Exposed Wires

EXPOSED portions of wires on coils or other small parts can be protected easily by coating the wire with ordinary rubber cement. After the cement has been applied, a bath of strong vinegar (or weak acetic acid) will serve to "vulcanize" the rubber coating, removing every trace of stickiness and providing a thin, transparent, and flexible insulating covering.

Loss-Free Insulating Material

Condenser with mounting of a new material

DESIGNED especially for short-wave work, a new insulating material serves as a mounting for the latest in variable condensers. Considered twice as effective as ordinary fused quartz, this new product is transparent and not easily cracked or broken.

New "A" Battery Is Smaller and Lighter

TO ANSWER the demand for smaller and lighter dry cells, a manufacturer has introduced the midget "number six" battery pictured. Composed of four smaller cells, connected in parallel so that the voltage totals 1.5 volts, it has a service life of approximately forty ampere hours. It occupies only two thirds as much room as does the standard "number six" cell, and is forty percent lighter.

Exciting New Water Sports

CREATED BY OUTBOARD MOTORS

Outboard motor boats racing in a swimming pool at Miami Beach, Fla. Because of their tiny size and easy maneuverability, such boats can race in small, confined areas

By JOHN E. LODGE

RIPPING through the choppy water of the Hudson River, at nearly forty miles an hour, recently, a tiny outboard racer streaked past the foot of Dyckman Street in New York City. It was Fred Jacoby's *Flyaway*, winning the classic Albany-New York marathon.

For 129 miles, its little twenty-four horsepower engine, buzzing like an infuriated hornet, had driven it downstream. After battling through rough water, rip tides, and shifting winds, Jacoby crossed the finish line three hours and twenty-eight minutes after his start. Once again, the outboard motor had demonstrated its amazing power and stamina.

Exactly a quarter of a century ago last summer, the first of these little "meat grinders" began pushing a rowboat across the surface of a Wisconsin lake. In the twenty-five years since their introduction, the midget power plants have seen service in all parts of the world. They have penetrated the upper reaches of the Amazon. They have putt-putted along the rivers of Central Africa. They have flown with Lindbergh; traveled to the Antarctic with Byrd. And their sale has passed the half-million mark.

Yachtsmen have propelled their sailing craft through canals with the detachable motors. Fishing fleets have ridden into harbor during dead calms towed by outboard-motored dinghies. Explorers have used them to ride through caves on winding subterranean streams, and hundreds of thousands of hunters and fishermen in all parts of the world have been able to enjoy their sport without the back-breaking labor of rowing.

Recently, an American couple traveled all the way across Europe, propelled along canals and streams by a small outboard motor. A few summers ago, an eastern judge packed his family in a twenty-foot outboard cruiser and followed the Ohio River from Pittsburgh, Pa., to the Mississippi and then wandered south to New Orleans, La. Outboard motors have been used to pump water

A sheet of flame forms one of the obstacles in an outboard steeplechase. At the left, one of the small engines propels a rubber raft

An outboard motor, geared to an air propeller, drives the ice boat pictured above. An automobile radiator cools it

in fire fighting; they have been attached to canoes, aquaplanes, cabin cruisers, rubber life rafts, and ice boats. During fighting in China, a few years ago, government officials used them to push barges of war materials up the shallow Yangtze River.

Of all the queer jobs these engines have been called upon to do, probably the strangest is one reported from Canada. Four hundred and thirty-three miles north of Quebec, in the Canadian wilderness, a gold mine needed new boilers for its engines. The nearest railroad was forty miles away. Wagon roads to the mine were virtually impassable. By turning to outboard motors, the owners solved their problem. The great, six-ton boilers were unloaded from the railroad, made water-tight, floated on a shallow stream, and pushed forty miles upstream by churning outboard engines!

The story of the outboard motor, and its quarter of a century of spectacular advance, goes back to a hot August day. A young Norwegian mechanic, the late Ole Evinrude, had gone on a picnic with several Milwaukee, Wis., friends. One of the young women expressed a desire for some ice cream, and Ole volunteered to row two and a half miles to the mainland to bring some back to their island picnic ground. On that five-mile grind at the oars, the idea of a small auxiliary engine that would take the place of a rower, first entered Evinrude's mind.

He had experimented at various times with gasoline engines, running one of his first models with illuminating gas from a jet in his boarding house and frightening the other boarders with its sudden volley of explosions. By 1909, he was tuning up the world's first outboard motor. It was a one-lunger that developed one and a half horsepower and weighed seventy-five pounds. The latest model weighs only twenty-four pounds and develops the same horsepower as the original engine.

Many of the motors now on the market can be carried by a boy of ten. Starting with the pull of a cord, riding to and from the water on an automobile running board, occupying but little space in a garage or cellar, these power plants are the acme of convenience.

In recent years, busy inventors have turned out electric outboards, auxiliary engines that run under water, outboards with five and six cylinders, engines cooled by air, and even "inboard outboards." To be an outboard, it is not necessary for an engine to be attached to the back of a boat. If the power plant can be detached and lifted out by hand, it is an outboard motor.

Advances that mark milestones in outboard history have been the introduction of the automatic reverse, the development of the twin outboard with its increased power and decreased vibration, and the adding of the tilting feature which permits the propeller to rise without being injured when it strikes a rock or sandbar.

In the improvement of the outboard motor, just as in the advance of the automobile engine, racing has played an important part.

During the early days, two and three miles an hour was the speed of rowboats pushed by the laboring little engines. By 1924, Judge Aaron B. Cohn, of Toledo, O., was causing a sensation at the Detroit Regatta of the American Power Boat

The "water bugs" get off to a flying start in a big race. Such events are growing in popularity

Association, by speeding around the course at twelve miles an hour with an outboard. In 1926, outboard racing began to sweep the country and now there are as many as 4,000 races run in a single year in North America alone. The competing boats run from those in the A class, with twelve-horsepower motors, to those in the F class, with sixty-horsepower engines. And, the races range from short circuits around barrel buoys to the most grueling contest of all—the race of the "water bugs" from Albany to New York City.

For eight years, this annual speed battle has attracted drivers from all over the country. As many as ninety contestants may line up for the start. Sometimes, only a dozen get through. The others are swamped by high waves, capsized by rip tides, stranded on sandbars, sent inshore with dead motors, flaming gasoline tanks, or disabled steering gear. Yet, out of 754 starters in the eight races, not one has been seriously injured.

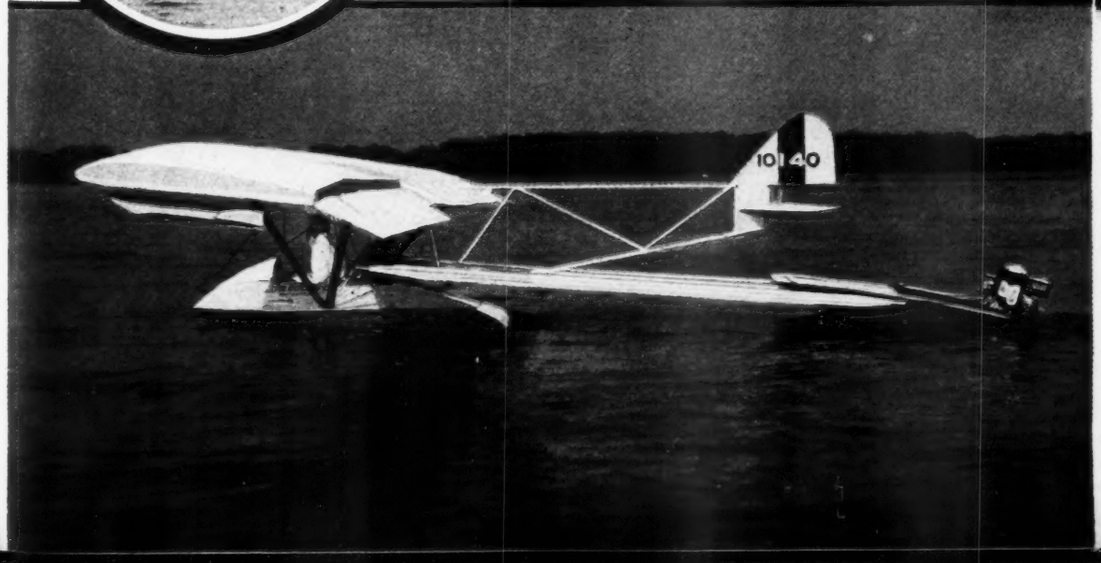
During this year's contest, one driver pulled into Poughkeepsie with his engine in flames. He smothered the fire, continued the race, and placed in the money. Another contestant saw a rival capsize, swung around, fished him out, put him safely on shore, and then headed downstream, still battling for the lead.

Sometimes, a plucky rider will lead the pack to within almost sight of the finish line and then be overtaken by disaster. In the 1929 race, J. T. Milliken, of St. Louis, Mo., was far out in front. Crowds lining the shore in upper New York City, were cheering him as the victor when his whining engine coughed and stopped. A glove, floating in the Hudson, had been sucked into the water intake and had plugged the opening, overheating the engine. While he drifted helplessly downstream, a tiny racer the color of an orange peel scooted past, and J. E. Wilkinson won the race.

Such twists of fate add to the

An amateur racer and his mechanic throw all their weight on the nose of their tiny craft, which points skyward when the engine is started

At the left, an outboard motor is seen in use as a pusher for a sailboat. They often are carried as auxiliary equipment



Outboards run a relay race. One of the contestants is passing the baton to a teammate. This is one of the new sports that outboards have created

The odd craft at the left has an airplane-like unit which rises from the water when it is pushed along by an outboard-powered boat on the surface. In the circle, it is seen in motion at high speed

Outboards sometimes do heavy duty. At the left, one of the tiny power plants is being used to propel a barge for emergency service across a river while the bridge is undergoing repairs

Hunters and fishermen have found outboards to be a great help in getting to and from the "good places." The photo at the right shows a couple of anglers in their outboard-powered boat. Below, a sailing yacht gets a boost from an outboard while making a long passage through a canal

excitement and fascination of the game. And this fascination grips young and old alike. The outboard bug is no respecter of persons. It bites college girls and millionaires, office boys and railroad conductors, fifteen-year-old flyweights and 200-pound men who are nearing sixty. In a single Albany–New York race, for example, the entrants included two surgeons, a banker, lawyers, college boys, a civil engineer, several farmers, a beer-garden proprietor, an oil-burner expert, the president of an insurance company, a Wall street runner, a transatlantic aviator, and a florist!

The night before the start of any long outboard race provides a colorful scene. Contestants, working under the glare of searchlights, tune up their motors and make last-minute adjustments on their brilliant-hued boats. Many of them sleep on mattresses thrown on the ground or on folding cots near their craft.

These boats, none more than sixteen feet long and many hardly longer than their riders, are coated with graphite paint or repeated rubbings of a special marine wax to reduce friction. Racing carburetors and, oftentimes, auxiliary lubricators are fitted to the engines. Terminals and cables are coated with grease as a protection against flying spray. The weight of connecting rods and pistons is calculated to the fraction of an ounce and the propellers are balanced until they will spin in the breeze of a small electric fan.

The more wealthy of the entrants use specially blended fuel. They have the cylinder walls lined with chrome plating. And they have all vital parts X-rayed as a protection against hidden flaws. While a racing craft can be purchased for $500, some enthusiasts spend $20,000 a year on the sport. They travel from race to race with a fleet of boats and half a dozen mechanics. Gar Wood, Jr., for instance, has a huge, specially designed aluminum truck that houses his boats and engines.

At the other extreme are the home-made hydroplanes, transported on trailers or driven to the scene of the race by their makers. In 1934, one of these backyard jobs left sleek, factory-built racers behind in the dash from Albany to New York.

It was constructed during spare moments by Fred Travis, a railroad conductor of Peekskill, N. Y. The Saturday before the race, Travis got off from work at noon, drove his boat up the river to Albany, got a few hours sleep, and was ready for the starting signal at seven o'clock the next morning. At the end of the 129-mile grind, he was leading the field in his class. After the judges had congratulated him, he headed upstream and drove home to Peekskill. Monday morning, he was back on the railroad run as usual.

At the start, the driver throws his weight forward to hold the nose down

As the speed increases, he moves back to balance boat on its hydroplane step

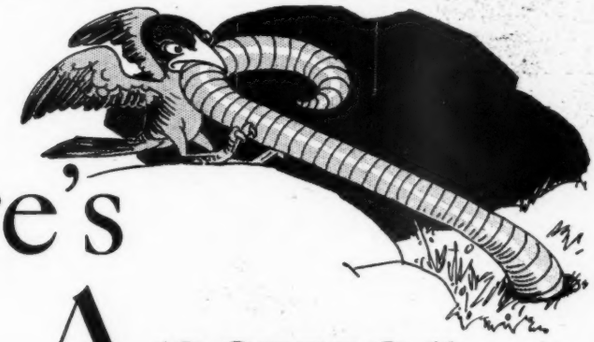
In making turns, he shifts his weight to keep the tiny craft on its course

In Florida, a few seasons ago, Elmer E. Dunn rented a motor for fifty cents, hired a boat for ten dollars, tuned it up a bit for experience, and then cleaned up at the Miami Beach Regatta. Outboard racing doesn't take years of experience to learn. Tyros have placed high in many contests.

At the start, the drivers throw their weight far forward to hold down the nose. Otherwise, the boats might veer off or somersault backward. As the speed increases, the rider moves back until he has the craft running on its hydroplane step. Kneeling, he balances the plunging little boat by shifting his weight. In rough water, the slapping and pounding of the waves against the 100-pound hull frequently leaves the rider black and blue. Many racers wear knee pads and tape cotton batting to their shins in preparation for a long race. In addition, all are required to don life jackets that will keep them afloat in case of an upset.

At top speeds, the little water whippets are literally hitting the high spots. They skim the surface like flat stones, making the best time when a breeze is kicking up the *(Continued on page 83)*

Question: What is the length of the largest earthworms?—F. F., Perth Amboy, N. J.

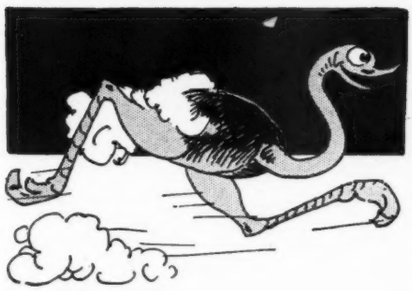


Here's *the* Answer

A.—IN NATAL, Ceylon, Australia, and South America, there are species of earthworms which grow to a length of six feet. In several tropical countries, specimens over three feet in length are common.

Polar Acoustics Are Good

R.N.O., SPOKANE, WASH. There are times when ordinary sounds can be heard over unbelievably long distances. Reliable observers report that in the Arctic the barking of dogs has been heard from ten to fifteen miles away. This phenomenon can be explained by the fact that cold, dry air is the best conductor of sound, and these conditions are found in the polar regions.



A Fast-Stepping Bird

R. D., PITTSBURGH, PA. When full-grown, an ostrich weighs approximately 300 pounds. Despite its weight, it is very fleet and, when alarmed, is capable of running at the rate of thirty miles an hour.

The Grimmest of Them All

W. L., DETROIT, MICH. The Black Death (bubonic plague) which swept Europe in the middle of the fourteenth century was probably one of the major calamities of history, not excluding wars, barbarian invasions, earthquakes, floods, and the World War. It is estimated that one-quarter of the entire population of Europe—at least 25,000,000 persons—was destroyed by the epidemic.

Where Days Are Born

Q.—WHERE is the international date line and what determined its location?—P. C. L., Meridian, Idaho.

A.—THE imaginary line on the earth where the change of date first takes place, known as the "international date line," runs for the most part along the 180th meridian, on the opposite side of the earth from the Greenwich meridian. This location was selected because, in this almost landless part of the Pacific Ocean, the change of date causes the least possible confusion. The line deviates from the 180th meridian in various places to avoid passing through land groups.

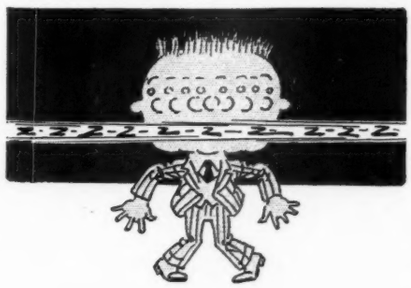
Starfish Hard to Destroy

Q.—IS IT true that if the arm of a starfish is torn off, a new one will grow in its place?—W. B. Y., Mobile, Ala.

A.—THE starfish can repair bodily injuries. If it loses an arm, a new one will be grown in its place. More remarkable than this is the fact that if an arm is broken off so as to include a portion of the central disk, not only will a new starfish be formed on the broken-off part, but this regenerated starfish will be capable of reproducing its kind. This is possible because the base of each arm contains an independent set of reproductive organs.

Seeing Beyond the Horizon

J. McK., TAMPA, FLA. Travelers tell of having seen objects at great distances. In Tibet, Mt. Everest was reported to have been seen from points found to be 400 miles distant from it. Vision at these long distances can be explained only by refraction, which is known to be extreme under certain atmospheric conditions. Refraction is the bending of paths of light passing through layers of atmosphere of different densities. Its tendency is to make the distant object appear higher than it really is. Thus we see the sun before it actually rises.



Fly Is Real Speed Bug

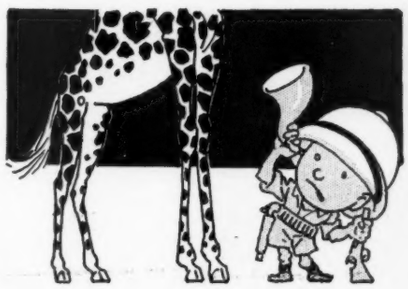
Q.—I HAVE heard about an insect in South America which is capable of flying 800 miles per hour. Can you identify it for me?—F. S. S., Reynoldsburg, Ohio.

A.—THE CEPHENOMYIA, or deer-bot fly, a native of North and South America and parts of Europe, can travel 815 miles an hour, nearly fourteen miles a minute, or 400 yards a second.

Lightning Strikes the Clouds

Q.—DOES lightning come from the earth and go up, or does it come from the clouds to the earth?—L. H. N., St. Louis, Mo.

A.—TWO research engineers, working in South Africa, with the aid of a high-speed camera of unusual design, obtained photographs of electrical storms showing that the main flash of a stroke of lightning is nearly always preceded by a faint "leader," which appears as an elongated, luminous dart traveling from a cloud to the earth. This leader averages 180 feet in length, is unbranched, and speeds downward at a pace ranging from 810 to 19,900 miles a second. The observers believe it to be an "electron avalanche" that ionizes the air, making it electrically conductive and thus paving the way for the main flash. As soon as the leader strikes the earth, the engineers found, the main flash starts upward along the same path.



All That Throat and No Voice!

Q.—IS IT true that the giraffe cannot utter a sound?—J. M., Portland, Me.

A.—THE vocal cords of the giraffe are atrophied to such an extent that for all practical purposes they are useless. Big game hunters have noted that the animals remain mute even in the agonies of dying. The few authorities who have heard giraffes utter a sound describe the sound as a faint bleat.

Space Offers Black Outlook

Q.—IS THE space beyond the earth's atmosphere, between the earth and the sun, light or dark?—W. B. H., Tacoma, Wash.

A.—THIS space is devoid of light. It is an area of perpetual night. The only manner in which it could receive light is for a planet or planetoid to pass through it, thereby reflecting the light of the sun.

Camel's Breach of Etiquette

Q.—IS IT a fact that the camel has the habit of spitting?—F. B. J., Kalamazoo, Mich.

A.—A CAMEL, when angered, ejects saliva at the object of its ire. At such times a slight swelling is perceptible in the glands of the animal's throat.

Worn Files Don't Bite

M. S. G., BIRMINGHAM, ALA. Files can be sharpened readily by following this simple procedure: Clean them with a wire brush and make certain they are free from oil or grease by wiping with alcohol or gasoline. Dry the files thoroughly and immerse in a solution made up of water, one pint; sulphuric acid, seven ounces; copper sulphate, two ounces; and borax, two ounces. This solution dissolves the thin, curled edges which prevent the file from biting. When *(Continued on page 96)*

"What seems to be the matter with Beelzebub today, son?" inquired Gus Wilson as he and Joe Clark, his partner in the Model Garage, pulled up and climbed out of the service car

By **MARTIN BUNN**

DO YOUR Spark Plugs MATCH YOUR DRIVING?

"CONFOUND you, Beelzebub! I wish I knew what was making you miss so." Young George Armstrong stared disgustedly at the motor in his beloved red roadster and wondered what test to try next.

"But, George," ventured the girl in the car, "it doesn't seem to miss when you don't go so fast. Why not drive a little slower and forget about it?"

"Huh!" George grunted. "That's just like a woman! You'd drive a car till the wheels fell off, without ever trying to find out what's the matter with it."

The girl offered no more suggestions, and George went on with his tinkering. "Can't be a spark plug, because I just cleaned them," he muttered. "Besides, it doesn't seem to be all in one cylinder. I've cleaned the timer contacts and they look good. Maybe it's water in the carburetor."

He looked up at this point in his speculations and caught sight of a service car coming down the road. He shouted and waved. "Hey, Gus! Got a minute to see what's the matter with my bus?"

"Sure have, young feller," grinned Gus Wilson, as he and Joe Clark, his partner in the Model Garage, pulled up and climbed out of the service car.

The veteran auto mechanic greeted the girl in the car. Then: "What seems to be the matter with Beelzebub today, son?" he inquired.

"Soon as I get to rolling, she starts to miss, especially if it's a bit of an up grade and I've got the throttle pretty well open," young Armstrong explained. "I've cleaned the spark plugs and the timer contacts, and I've tested the spark. It's fully a quarter of an inch long, and nice and blue. I was just about to pull the carburetor apart to see if there's some water in it."

Gus never took anything for granted. He removed the spark plugs and carefully inspected them. Then he asked the girl to step on the starter pedal while he watched the timer make and break contact. At the same time he observed the spark jump from the coil high-tension wire which he held, by means of insulated pliers, about a quarter of an inch from the cylinder head.

"Why use those trick pliers?" Armstrong asked. "Is the wire so old you think it will leak and give you a shock?"

"What's the use of taking a chance with high-tension current?" Gus countered. "There may be a bad spot in the wire, and then you're due for a swift jolt that will make you jump like a jack rabbit even though it won't do any real damage.

"And besides," Gus went on, as he carefully measured the spark-plug gaps, "if the hand you use to grab the high-tension wire is damp and your other hand is resting on a metal part of the car, you can get a bit of shock even if the wire is perfect. That's because your hand acts like one plate of a condenser, with the wire inside the insulation acting as the other. Any radio shark will tell you high-frequency current, and that's what spark plug current really is, will travel between the plates of a condenser no matter what's in between."

"Anything the matter with those spark plugs?" Armstrong asked, as Gus put the last one down and spread out several blades of his thickness gauge, preparatory to determining the exact width of the openings of the timer contacts.

Gus did not reply until he had finished this measurement. "I don't blame you for getting fooled this time, son," he grinned, as he stood up and stretched himself to straighten the kinks out of his spine.

"There's a lot of little things the matter with your ignition. Not one of them would cause any trouble by itself, but when they gang up on you the result is nearly no spark at high speed. Take those plugs, for instance. They're clean and in perfect shape, only the points have burned away a little so the gaps are a little wide. The breaker points, too, have a clean, gray surface that shows they're making good contact, but they're set so they open too far. That means that they don't stay in contact quite long enough at high speed. On top of that, this is a high-compression motor and there's some carbon deposit that raises the compression still higher. And the coil, while it isn't so bad, is not as peppy as it might be.

"Fix any one of those things," Gus concluded, "and you'd stop a lot of the missing. Fix two of them and I doubt if it would miss at all—for a while, anyhow."

Gus adjusted the breaker points while Armstrong finished the plug points. The last the two garage men saw of Beelzebub was a red dot disappearing down the road to the accompaniment of a smoothly buzzing exhaust.

"Nice kid, that young Armstrong," Gus observed to Joe Clark, as he turned the last bend in the road and caught sight of the garage. Standing in front of the building he saw a *(Continued on page 68B)*

TARGET PRACTICE WITH

Mayan Throwing Sticks

By Clark H. Rutter

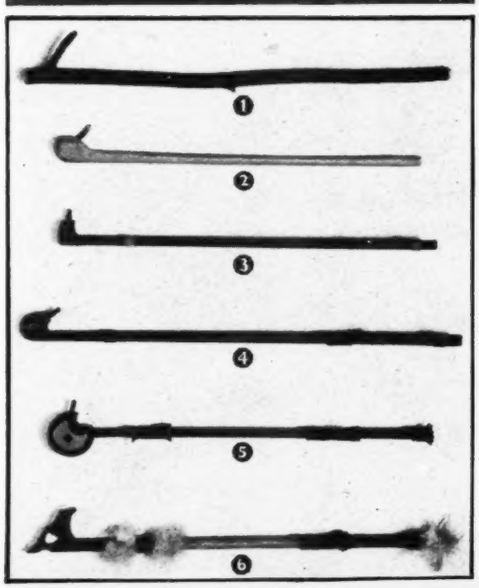
How to make equipment for a novel outdoor sport . . . Arrows are hurled with the aid of a curious ancient weapon instead of being shot

HERE is a fascinating sport that requires little equipment and is quickly mastered—hurling arrows at a target with a homemade hul-che, or Indian throwing stick.

The hul-che was one of the weapons used by the ancient Mayas in Yucatan and other parts of Mexico and Central America. It is merely a stick with a protruding head or peg, which engages the end of an arrow. By means of the stick, the arrow can be thrown great distances with surprising force and accuracy. Unlimited skill may be gained by practice; the exercise is a healthful one; and the sport becomes highly competitive when engaged in by a group.

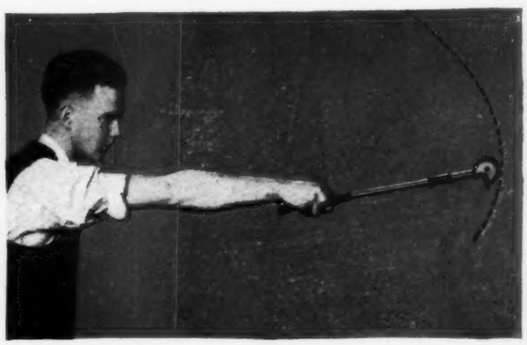
The sticks illustrated are not copies of authentic Mayan designs, but represent a few of the many types that may easily be fashioned.

In the photograph at the left, showing a group of six sticks, No. 1 is made from the forked limb of a tree. The smaller branch is burned off to harden and round it so that it *(Continued on page 93)*



THROWING STICKS

Six suggested designs. Lengths may vary from 20 to 27 in., and the pegs can be set at any angle from 45 to 80 deg. The first is merely a branch of a tree; the second and third are almost as simple; but the remaining three are carefully made

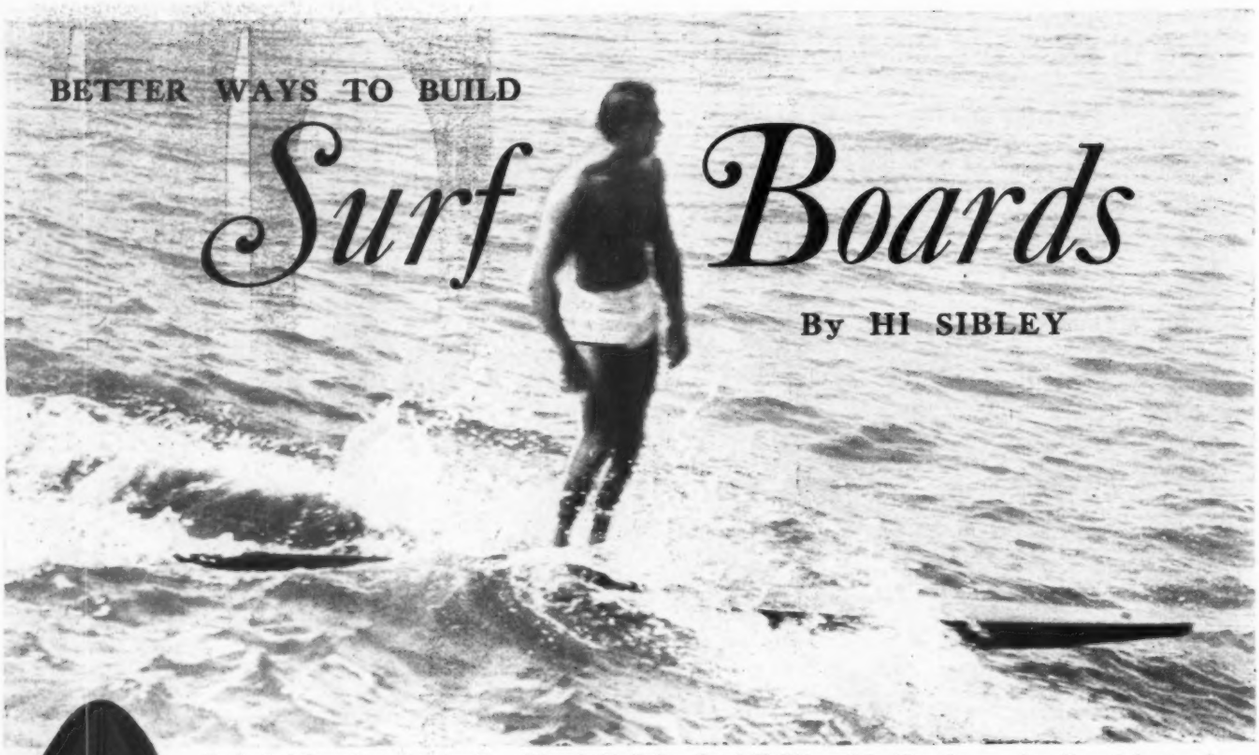


Beginning and end of the throwing stroke are shown at the right

BETTER WAYS TO BUILD

Surf Boards

By HI SIBLEY



Perfectly balanced on a homemade surf board, this Balboa Beach (Calif.) youth is riding the ground swell, not being towed

AT THE California beaches there are schoolboys who easily rival the best Hawaiian experts in the thrilling sport of surf-board riding. That is partly because of the superior surf boards they use—light, buoyant, and beautifully finished.

With the aid of the accompanying drawings, any amateur woodworker can build equally good surf boards. These designs are of the type used at the Newport Harbor (Calif.) Union High School, where construction of surf boards is a specialty. Two of the plans are for large boards, which may be paddled far from shore and used in deep water; a third design is for a smaller and simpler board of the toboggan type; and the fourth is a child's paddle board.

The balsa-wood surf board shown in Fig. 1 is so light that it can be carried about easily, and it has exceptional buoyancy in the water. Since balsa has no great strength in itself, the board is reënforced

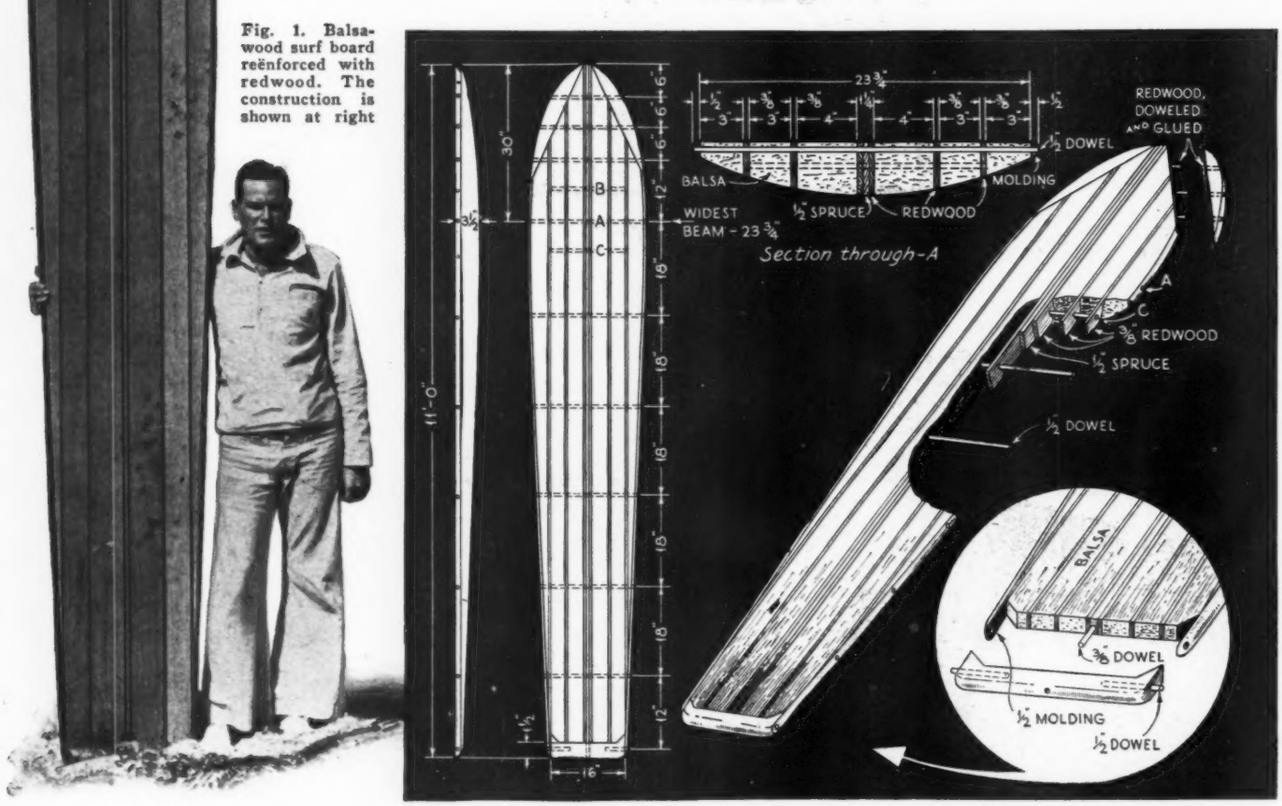


Fig. 1. Balsa-wood surf board reënforced with redwood. The construction is shown at right

A reënforced balsa-wood design—Laminated pine-and-redwood construction—Curved-head or toboggan types—Boards for children

with redwood longerons and a central backbone of spruce sandwiched between two pieces of redwood. There are no nails or screws, the sections being securely held together by dowels and casein glue.

The first step is to make the backbone. It is a ½ by 3½ in. strip of spruce glued between two ⅜-in. redwood strips of the same width. On each side of the backbone, glue balsa timbers, 3½ by 4 in. by 10 ft. 11 in. Continue to add strips of redwood and timbers of balsa, as indicated in the cross-section drawing. Two dowels, marked *B* and *C*, should be inserted before the two outer pieces of balsa are put on. Their centers are located 1½ in. from the top. When the assembly is completed, shape the built-up plank by cutting the outline as illustrated in the plan drawing. Allow about ¼ in. all around for trimming to exact size. Before doing the trimming, however, plane the bottom to a taper, fore and aft, from the widest beam, which is 30 in. from the nose.

After the board has been planed and sandpapered, glue the curved sections on the nose, and add the stern piece, which should be of redwood. When the glue has set, bore holes for the dowels and insert them. Note that the centers of all except the two previously mentioned are located about ¾ in. from the top.

The ½-in. half-round molding should be neatly fitted, and the finish will be greatly improved if redwood plugs are set in over the ends of the dowels.

If waterproof casein glue has been used liberally in all joints so that water will not seep into the porous balsa, give the entire board four or five coats of spar *(Continued on page 91)*

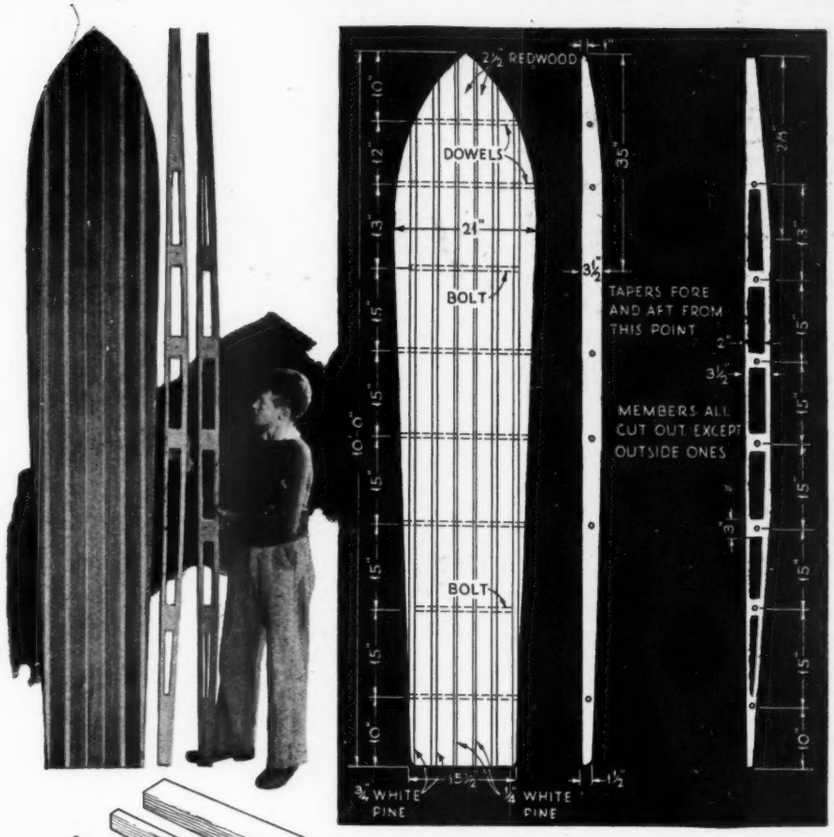


Fig. 2. How to make a laminated surf board of redwood and white pine. To reduce the weight, all the strips except those on the outside are cut away as shown. A finished board appears in the photo at left above, together with two sections. The method of assembly is indicated at the left

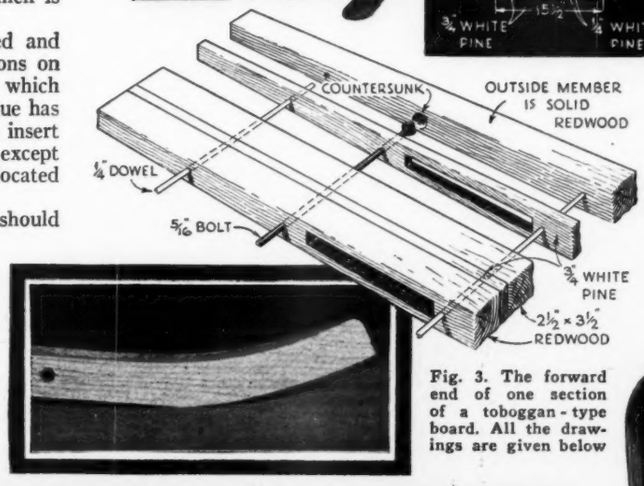
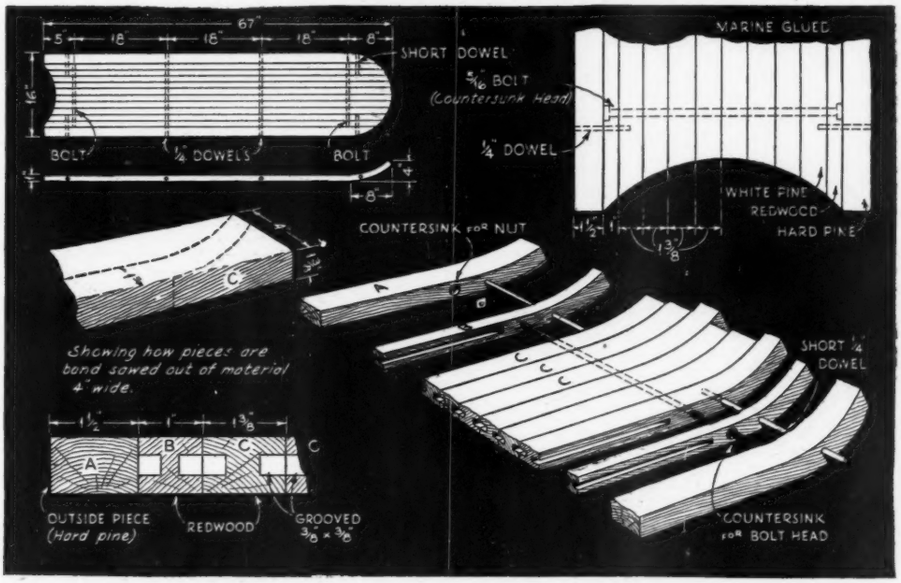


Fig. 3. The forward end of one section of a toboggan-type board. All the drawings are given below



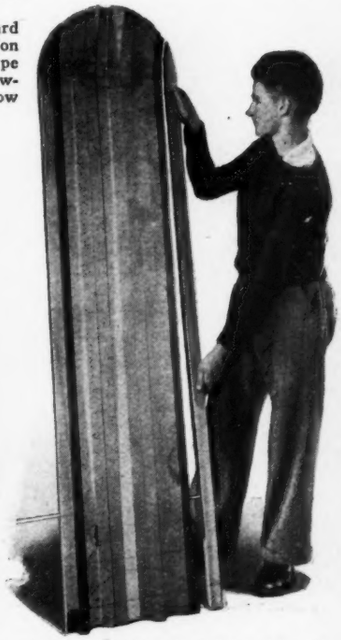
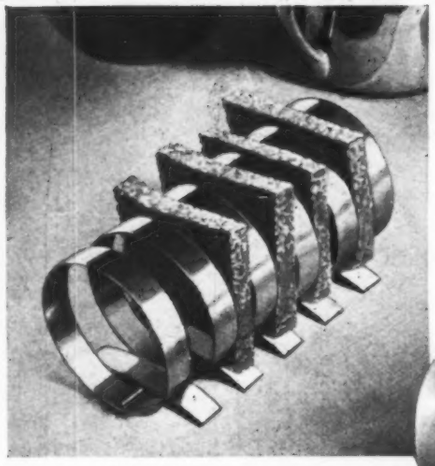


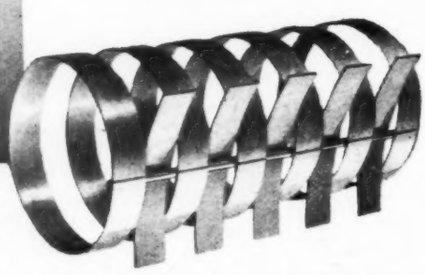
Fig. 4. Pat Waldron, of the Newport Harbor (Calif.) Union High School with a partially completed toboggan surf board, made as shown at the left

Modern Toast Rack

MADE OF ZINC AND BRASS



A decorative toast rack made up of zinc rings and brass feet. These are interlaced on a brass rod and soldered in place as shown at right

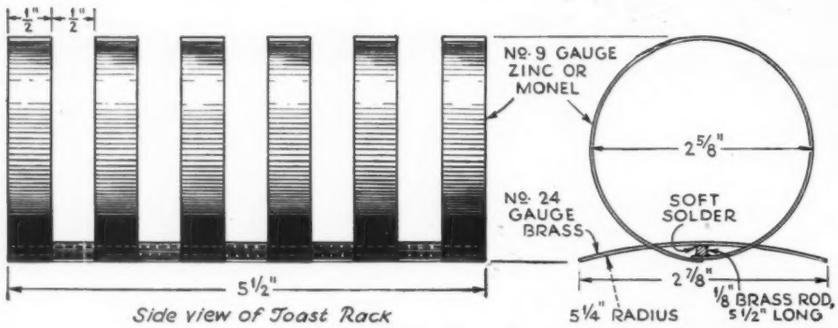


MODERN in design, the zinc and brass toast rack illustrated is a good project for the beginner in metal craftwork as the only tools needed are a pair of tin snips and a soldering iron.

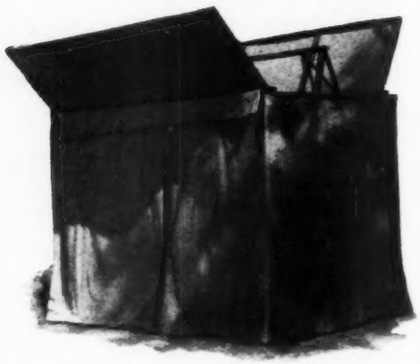
The materials required are enough No. 9 gauge zinc to make six strips ½ by 8⅝ in.; five pieces of No. 24 gauge brass ½ by 2⅞ in.; and a piece of ⅛-in. brass rod, 6 in. long. Scraps of zinc and brass can be obtained from a tin shop for a few cents. Monel metal may be used in place of zinc, if available.

After being carefully polished with fine steel wool, the zinc strips are formed into rings, one at a time, by carefully wrapping them around a bottle 2⅝ in. in diameter and soldering the joint. The five brass feet are then polished and formed to the radius given in the drawing. The rack is assembled by soldering one of the rings to the brass rod, then a foot, and alternating until all of the rings are in place. The rings are soldered under the rod, and the feet over the rod.

When soldering the parts of the rack together, particular care should be taken to get a smooth joint. After the assembly is complete, any surplus rod extending beyond the ends should be carefully cut off and the entire piece given a brilliant polish.—DANIEL REYNOLDS.



Dimensioned side and end views of the rack. Note that monel metal may be used instead of zinc



CURTAINED LAWN SWING USED FOR SUN BATHS

A LAWN swing of the type illustrated below may easily be provided with curtains so that it can be used for taking sun baths in comfort and privacy. A light framework of angle iron is fastened around the four sides of the swing at a point 12 in. or slightly more below the top. The canvas side walls are attached to this support, and the two roof frames, which may be of wood, are hinged at the front and back of the framework as shown. Ordinarily the canvas-covered roof is closed to form a canopy, but for taking sun baths the two wings are pushed open as illustrated above.—MADS S. MOLLER.

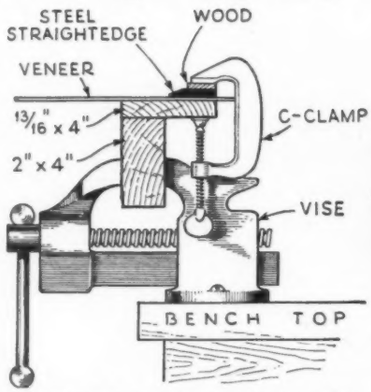
Lawn swing with canvas side walls that can be closed, and a hinged roof which will open

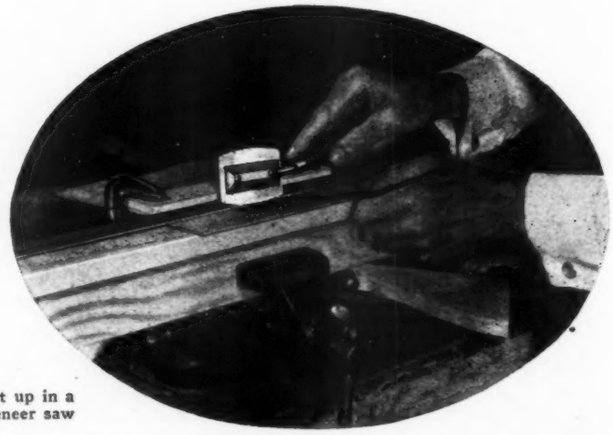
BUSHING MADE FROM COUPLING

IN electric conduit work, a reducing bushing may be made from a conduit coupling merely by cutting the next size larger thread outside the coupling.—L.G.

Table for Cutting Long Edges of Veneer Perfectly Straight

FOR cutting veneers, a convenient method is to make an L-shaped rest or table as shown. This is merely a length of 2 by 4 in. stock with a 13/16 by 4 in. piece nailed on top, flush with one side of the 2 by 4. It is set up in a vise, the veneer laid on top, and a straightedge held in place with a pair of C-clamps to guide the veneer saw or knife. You are then sure to get clean, true edges because everything, including the straightedge, is solid for cutting.—THOMAS B. OWENS.





End view of the table showing how it is set up in a vise, and, at right, cutting veneer with a veneer saw

UNIQUE MAPLE *Lamp Table*

Copied from a Colonial Cobbler's Stand

By CHARLES D. PRICE

This is a reproduction of a piece by some ingenious village carpenter of the eighteenth century. The original was of pine and maple, but this is all maple. It can be wired for electric lamps or used for candles as in the drawing above

ANYONE who has made a study of early American furniture cannot help but be impressed with the many odd and curious examples of Yankee ingenuity. The illustrated cobblers' stand is a reproduction of an eighteenth century one that was propably the work of some village carpenter. The only change is the substitution of electric lights for candles. This stand has the advantage of lights that are adjustable, plus a top of ample size to hold smoking accessories and several books or magazines.

The original was made of maple and pine, but all maple is preferable. A nicely figured piece for the top will add greatly to the appearance of the finished article.

The feet (see list near end of article for dimensions of stock) are fitted together with a tight half-lap joint. Two mortises, ½ by 1⅛ in. and 1 in. deep, are cut in each foot where shown.

A tenon 1 in. long is cut on the bottom of each leg, and one ¾ in. long on the top. Both tenons are cut only on the thickness, stepping it down from ¾ to ½ in.

The cleat for the top requires four mortises cut all the way through to receive the legs. The ends of the cleat are tapered down at each end as shown.

Although the top is given as ½ by 13 by 17 in., it may be a little larger if the feet are made longer in proportion. The cleat is fastened across the underside of the top with screws. A thin molding around the edge of the top will keep small objects from being pushed off and cover the end grain.

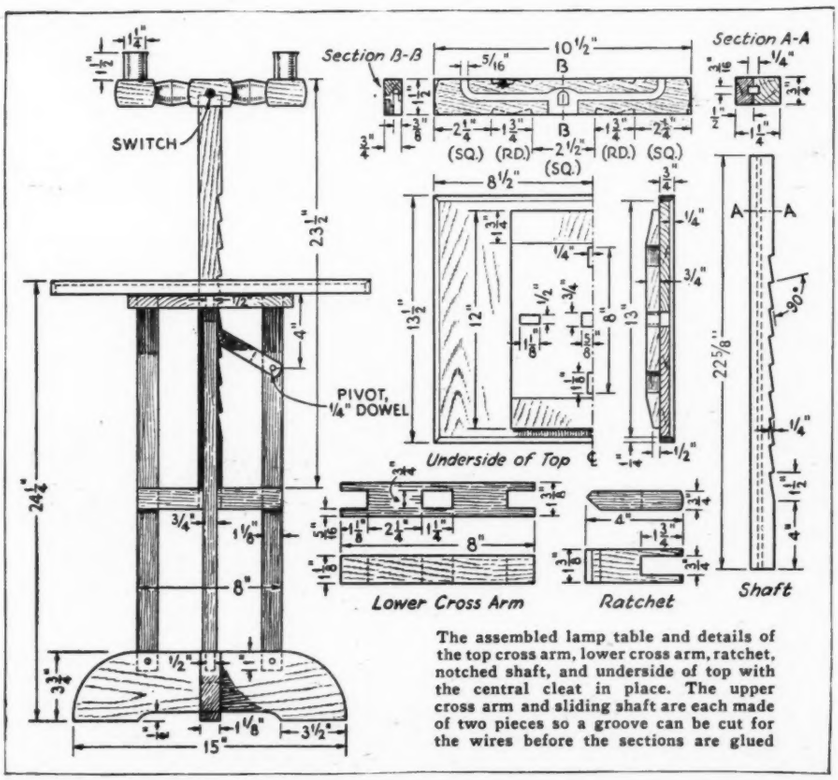
Use center lines on the cleat to locate the aperture for the adjustable shaft. It is ¾ by 1¼ in. and goes through both cleat and top.

The notched shaft is made from a piece ¾ by 1½ by 22⅝ in. A strip ½ in. wide is sawed off, and the ¼-in. allowance is for the saw cut. The center of both pieces is rabbeted out for the wire, as indicated in the sectional detail. The pieces are glued together; and before the glue sets, a wire should be pushed through the groove to flatten out any lumps of surplus glue. The shaft is next trimmed to the finished width, 1¼ in., and the nine notches are cut.

The horizontal support for the lights is made by gluing two pieces together. A channel is carved on the inside surfaces as indicated. The distance from center to center where the channels come out on the upper surface is 8¼ in. The mortise for the shaft should be cut before the pieces are glued together; it extends to the channel. A recess is next cut on one piece for a flat switch, which must be thin enough to allow the shaft to fit in the mortise. The pieces are then carefully glued and tightly clamped together. Be sure that the channels match perfectly. While the glue is still wet, run a wire back and forth through the channel. The piece is later centered on the lathe and turned.

The lower crosspiece is made to fit tightly on the shaft and slide freely on the legs.

One end of the ratchet is cut out as shown to allow it to be pivoted on the leg. The angle on the *(Continued on page 73)*



The assembled lamp table and details of the top cross arm, lower cross arm, ratchet, notched shaft, and underside of top with the central cleat in place. The upper cross arm and sliding shaft are each made of two pieces so a groove can be cut for the wires before the sections are glued

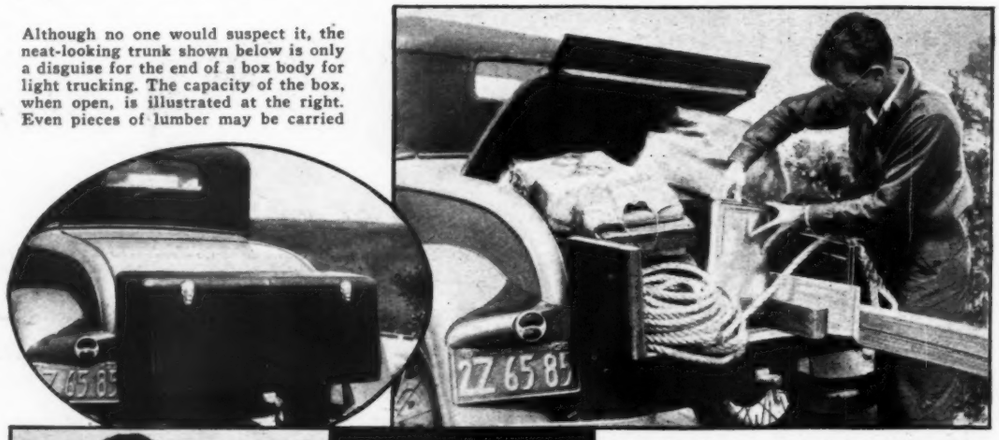
Imitation Auto Trunk Conceals Light Trucking Box

BY A SIMPLE bit of carpentry, an ordinary roadster or coupe can be made to serve for any business that requires light hauling or pick-up work. The change is brought about by the addition of a false trunk that in reality covers a box extension for trucking. When the car is used for pleasure, the box is entirely disguised. A car thus converted is handy for camping trips and for hauling materials such as lumber that otherwise would need to be carried on the fenders, and is the ideal solution for a traveling salesman who needs an attractive car, yet has to carry luggage and samples in considerable quantity.

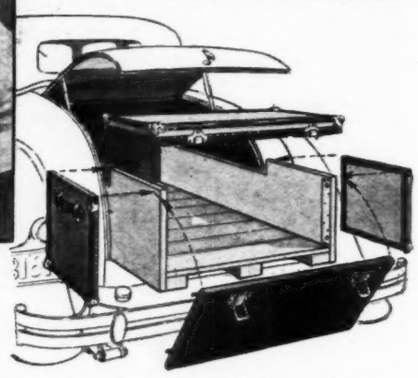
To make the change, remove the tire rack, if this is carried on the back, and remove temporarily the hinged door to the back compartment for convenience in working. If the back compartment houses a rumble seat, it will be necessary to change the hinges from the back bottom to the top and, of course, remove the seat entirely. The panel below the back-compartment door is then removed and, in certain makes of cars, some of the metal floor coverings. These are taken out to facilitate fastening the trunk base timbers in place.

The timbers can be ordinary 2 by 4's running with the length of the car and fastened to convenient body members with ¼-in. bolts. They should project beyond the end of the car from 12 to 14 in., depending upon the size of the car being converted and the size of a trunk that looks well on the car. Three of these supporting pieces are ample, one on each side and one in the center. Since no really heavy hauling can be done with these types of cars, the 2 by 4's can be laid flat to lower the truck floor and give an added bit of room.

Although no one would suspect it, the neat-looking trunk shown below is only a disguise for the end of a box body for light trucking. The capacity of the box, when open, is illustrated at the right. Even pieces of lumber may be carried



Loading the box. Note that a narrow strip of sheet metal has been attached to the back cover to fill in the gap between the cover and the trunk when the back is closed



A drawing to show how the design and construction of the trunk may be varied as desired. *At left:* Two operations in making the extension

Flooring, either 1 by 6 in. lumber or tongue-and-groove stock, is then cut and nailed to the base timbers. The truck sides are made of 1-in. lumber of a width equal to the remaining space left between the new flooring and the position that the rear compartment cover will strike when it is let down. The sides are, of course, run from inside the car and continued out flush with the end of the flooring. They are bolted to body members inside the car and screwed through the flooring where they project.

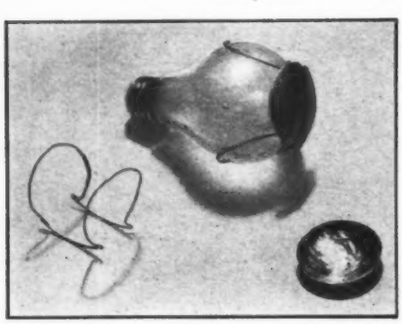
With this much done, the disguising of the new truck extension is undertaken. Here care must be taken to do a workmanlike job. The false ends of the trunk may be constructed with rounding corners and covered with suitable trunk or top material, tacked inside; and they are then fastened to the side extensions of the truck from the inside with flathead, countersunk screws. The backpiece of the false trunk is then made and covered. It fits between the trunk ends and is held in place with ordinary door bolts of the sliding and locking type. The bolts engage holes in the trunk ends. The trunk top is next made, covered, and fastened in the same way as the back. Thus both parts can be removed quickly and easily by sliding the bolts back.

The gap between the back of the back cover and the forward part of the trunk is filled in with a metal sheet attached to the back cover and suitably reënforced. This can clearly be seen in the topmost of the group of photographs above.

The only remaining work is to paint the exposed parts of the false trunk and add trunk fittings to give a finished appearance.—NORMAN DAVIDSON.

CUP-SHAPED DISK DIFFUSES LIGHT

THE simple but efficient light diffuser illustrated is designed for photographic use in conjunction with any type of metal reflector. It may also be used in reading lamps and indirect lighting fixtures.



A 2-in. tin disk is beaten into a cup shape to fit the curve of the bulb with which it is to be used and is then polished. A piece of spring brass wire, 15 in. long, is bent in the form illustrated to hold the disk to the bulb. The ends of the wire may be twisted or soldered together.

In use, the disk eliminates light coming directly from the filament, and all light must be reflected from the larger metal reflector. According to tests made with a high-grade light meter, less than ten percent of the light is lost with this diffuser, whereas the linen tracing cloth commonly used for this purpose absorbs very much more.—WALTER E. SANDERS.

GUILD CLUBS DISPLAY WORK

In Many Local Exhibitions

Official Magazine
POPULAR SCIENCE MONTHLY

BY E. RAYMOND DE LONG

Secretary, National Homeworkshop Guild

General view of part of the exhibition of the Yakima (Wash.) Homecraft Club. The scroll saw in the foreground was the grand prize. *Below:* Marionette theatre by Arthur S. Lewis, which won a silver medal at the National Guild Exhibition

EXHIBITIONS by a number of local clubs brought to a close the active season of the National Homeworkshop Guild. Some of the clubs will continue to meet during the vacation months; others will concentrate on sports such as archery, for which the members can make their own equipment; and many of the organizations will hold outings or picnics.

Practically all the 178 clubs in the Guild, except those formed within the last few months, have given exhibitions of some kind since the early fall of 1934. Forty-one of the larger clubs held contests in connection with their local exhibitions. To each of these clubs, POPULAR SCIENCE MONTHLY donated a sterling silver medal to be awarded as a special craftwork prize.

Here is a striking index of the activity of the Guild. Merely to print a brief summary of the news relating to it has required ninety-one columns in this magazine since the September, 1934, issue.

The most encouraging feature of the season's work was the extraordinary success of the first National Handicraft Exhibition and Contest of the Guild held in Chicago last March (P. S. M., June '35, p. 57, and July, p. 68). The local clubs have also made great strides. Several of them have started auxiliaries for boys, are conducting craftwork classes, and are publishing their own bulletins; a great many made toys for needy children last Christmas and will do so again; and a vast amount of constructive work has been undertaken to promote the home workshop hobby.

Late as the season is for new clubs, charters have been granted the Tacoma (Wash.) Hobby and Homeworkshop Club; Arts and Crafts Club, Freeport, Ill.; Miami (Fla.) Homecraft Club.

Brunswick (Me.) Homeworkshop Club. The season's work concluded with a well-attended dinner, to which were invited the various craftsmen who had given demonstrations before the club. The dinner was followed by a motion picture. At a previous meeting Otto Gruenewald, a professional interior finisher and decorator, gave a talk on wood finishing and demonstrated the staining and finishing of various woods. Ralph Derby also gave hints on reading and using various kinds of calipers.

(Continued on page 82)

A group of articles displayed at exhibition of the Lincoln (Nebr.) Homeworkshop Club. Three prize-winning projects are shown on page 82

Turn to page 76 for classified list of blueprints.

Spring-Driven Cruiser Model

Built with frames and planking by new method any one can master

By E. F. WALDRON

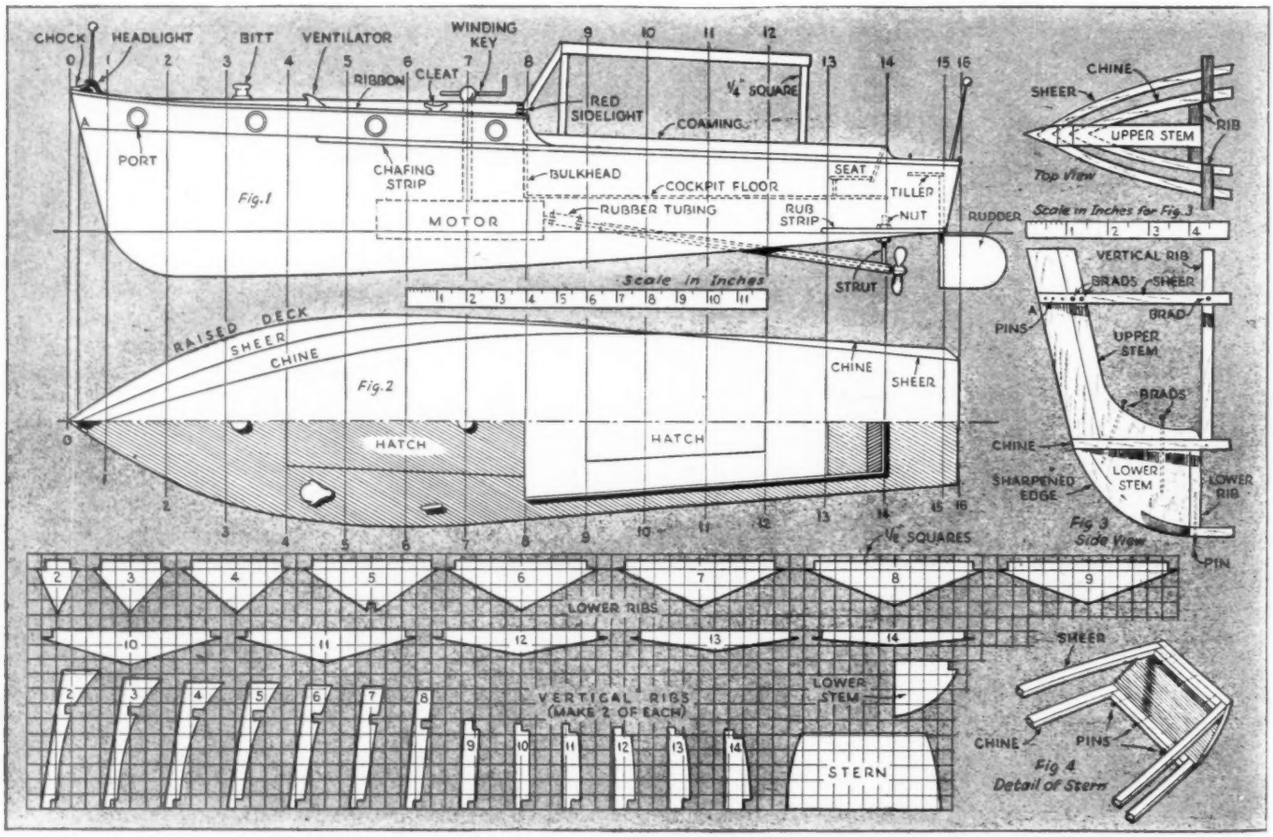
The finished model, which is 30 in. long, is driven by a five-minute spring motor. *At left:* Mr. Waldron is holding the partly finished frame of a similar boat

ALTHOUGH this 30-in. motorboat cruiser model is built up with frames and planking in the most approved style, it is so simple in construction that a beginner can build it without difficulty. Even boys of fourteen have made it successfully. That is because of the new and original method by which it is assembled. The principle is the same as that used in making a sailing model of a schooner described in a previous issue (P.S.M., Sept. '34, p. 86); in fact, the workmanship required for this boat is only one step in advance of that needed for the schooner.

The model is a typical cruiser, but not a copy of any existing boat. Certain liberties have been taken with the chine line for simplification of construction, making it more like the older V-bottom type. Straightening the chine line enables the boat to be assembled on a building board. Since the hull is narrow as well as deep at the bow, not a plank needs steaming or even soaking in water. All can be bent into place while dry and fastened immediately.

Dimensions can be found by using the inch scales and the ½-in. squares on the drawings below. Close measurements, however, are not required. Once you have laid out full-size sheer and chine lines as described later on, you will have little difficulty in cutting the parts to fit as you proceed.

Tools. A good razor-blade knife (see P.S.M., Dec. '34, p. 108), a jeweler's saw frame and blades, coping saw, screw driver, plane, pin drill and drills Nos. 55, 60, and 65 (or flattened and pointed nails will serve



Assembly views; the shapes of the ribs, lower stem, and stern, all drawn on squares that represent ½ in. each; and detail drawings of stem and stern

as drills); a bit brace, ½-in. bit, and ⅛- and ¼-in. wood drills; sandpaper, and a paper of pins.

Materials. Thirty strips of wood, preferably white pine, ⅛ by ⅞ by 36 in. for sides, bottom, and deck planking. (You can buy a ⅞-in. board and have it ripped into ⅛-in. pieces at a mill, or by a friend who has a circular saw, if you do not own one yourself.)

Ten strips ¼ by ¼ by 32 in. for chine, sheer, inner and outer keel pieces, cross braces used in the sheer section of the framework, and cockpit floor beams.

One piece ¼ by 6 by 40 in. from which to cut the ribs.

One piece ¾ by 1½ by 10 in. to make the inside and outside stem.

One piece 1 by 9 by 31 in. for a building board.

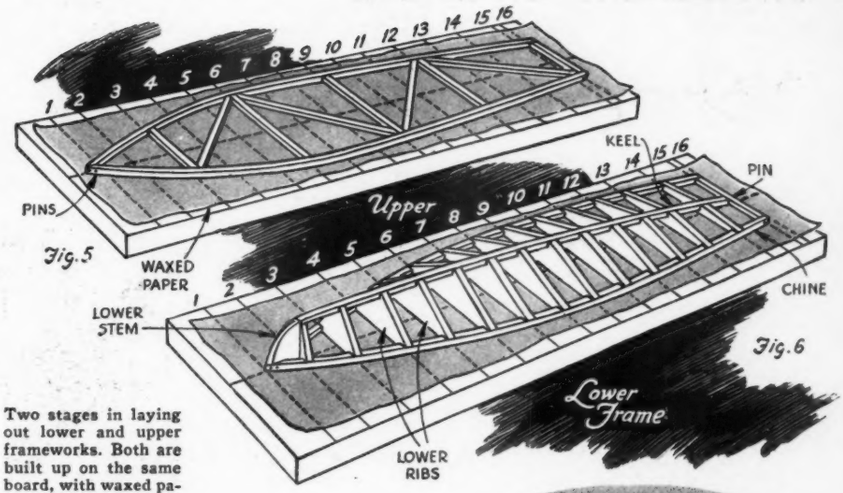
One quart (approximately) of celluloid cement. This can be made by dissolving 8 oz. scrap celluloid in 1 qt. acetone. It is inflammable, so keep away from flames, no matter how small.

Two dozen ½-in. No. 4 roundhead screws and washers, and ½ oz. of ⅜-in. No. 20 brass escutcheon pins.

Lower Frame. Draw center line on building board. At right angles to it draw a line across the board 1 in. from one end. Draw another line ⅞ in. from the first. Then draw cross lines every 2 in. Copy the sheer and chine lines from the plan (Fig. 2) onto this board and lay a piece of waxed paper on it. These lines are marked clearly on the plan. The sheer line is the upper line of the sides of the hull proper (not including the line of the raised deck, which flares out still farther). The chine line is the lower line of the sides of the hull. Note particularly that at the stern the hull is wider at the chine line than at the sheer line; therefore towards the stern the sheer line is inside the chine line.

Tack a ¼-in. square piece of wood to the building board with pins driven part way in, inside the chine line beginning at the stern. It must follow the curve exactly. At the bow cut off this piece on the center line. Tack a similar piece for the other side of the chine and trim off to match first piece at bow. Put cement between the ends, nailing them together with pins driven through both and bent over.

At stern cut a crosspiece of ¼-in. square material to go between chines at station 15. Glue in place and hold with pins driven through chine into cross beam.



Two stages in laying out lower and upper frameworks. Both are built up on the same board, with waxed paper to prevent the cement from sticking

When the two frameworks have been prepared as in Figs. 5 and 6, they are assembled with the upper stem and the stern as shown in the photo below

Pins are used to fasten down the parts on the building board until the cement holds. Compare this with Fig. 6 above

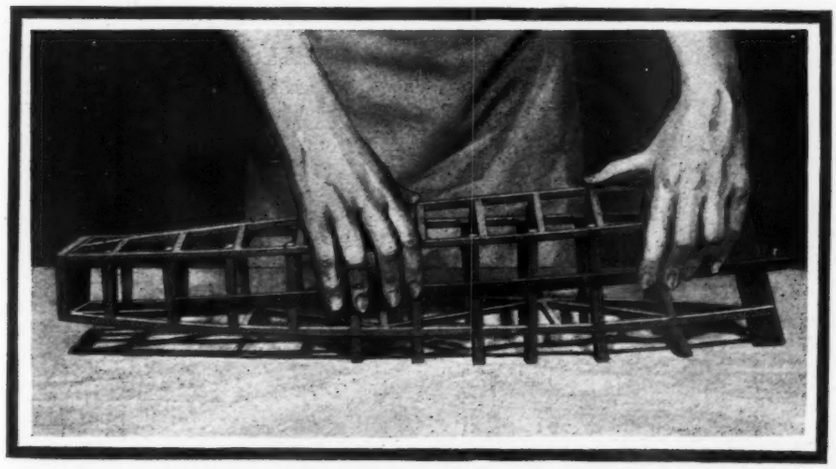
Cut out all lower ribs as in drawings given on ½-in. squares. Cut a ¼-in. square notch in the point of each as shown for rib No. 5, and cement all into place on chine pieces as illustrated in Fig. 6. Cut out lower stem piece as shown on the squares. Shape its front edge to a point and fit and glue it at front of chine (see Fig. 6). Fit inside keel piece (a ¼-in. square, straight strip) into notches in lower ribs. Nail it at stern and at rib 2 with a pin driven all the way in. Use plenty of cement in these notches. When it is dry, remove lower frame from building board.

Upper Frame. Lay down two ¼-in. square pieces as before, but inside the sheer lines instead of the chine lines (Fig. 5). Put in a stern beam at station 16. Every 6 in. (or at every third line drawn on the building board) glue in a crosspiece. Then glue in diagonal braces as in Fig. 5. When dry, remove from board. The braces will be removed when planking is completed.

CUT out upper stem piece as in Fig. 3. It is 5 in. high and 1 in. wide, for about 3 in., where it curves out into a knee that extends back to the first rib. Sharpen the front edge so that it matches point of chine. Notch it for sheer frame at *A*, Fig. 3, so that when fitted together, the front edge is even with point of sheer. Glue and nail stem in place with 1½-in. brads on chine frame as in Fig. 3. Be sure that stem is straight up and down; if twisted from the perpendicular, a misshapen boat will result. Extreme care is necessary here. Cut out stern board and fasten to chine frame, then to sheer frame as in Fig. 4. Use pins and glue. Slip front of sheer frame into notch of upper stem and fasten with pins, driven part way in and cut off; then coat with cement. Cut out two No. 10 upper (vertical) ribs as shown on the squared drawing. My method of fastening each upper rib is to drill a hole in the rib for a ½-in. No. 20 nail, insert the nail, and while holding the rib in place, squeeze the nail into the chine or sheer with a pair of pliers. These nails hold the rib while the glue sets. Cut out remaining upper ribs. It is preferable to lay out one of the ribs on the ¼-in. board, tack another piece of ¼-in. board to it and saw out both ribs of each pair at once. When cut and notched, insert these ribs at their proper stations with glue and hold with small nails or pins.

Now check the hull for errors in sawing or copying of curves. A small square piece of wood is sprung over a number of ribs and slid up and down the frame so that it spans at least four ribs. If it does not touch all of them at all points, the ribs should be sandpapered or shimmed out.

Instructions for the planking will be published in the September issue.



Checking the ribs with a flexible batten, which must touch at least four at a time at all points

SIMPLE TREE SURGERY PREVENTS DECAY

The tools needed—pruning saw, mallet, two chisels, wood rasp, pruning shears, and, of course, a pocketknife or other blade

After a branch has been removed, taper the bark towards the cut with a sharp knife. *At right:* The bark tends to grow over the wounds if they have had careful treatment

IN PRUNING trees, it is sometimes necessary to cut off comparatively large branches. Merely cutting the branch close to the main trunk is not always sufficient, because the tree is likely to bleed through the short stump that is left and occasionally fungus will attack the spot and the tree will start to decay.

The tools needed for properly finishing a cut are: a pruning saw (not an absolute necessity, but inexpensive and very convenient); a mallet or hammer; a wide chisel (1½ in., for example); a wood rasp (not essential, but convenient for making a smooth surface); a narrow chisel (½ in.); a sharp knife; and pruning shears. In addition, I use a small paintbrush and a can of liquid roofing cement.

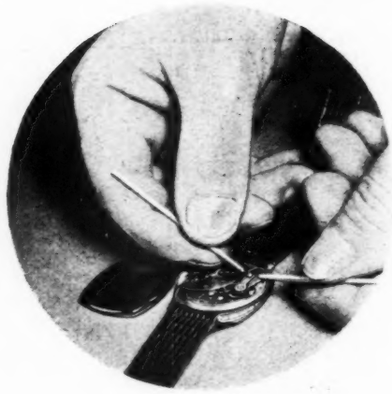
After the stump of the pruned limb has been sawn as close to the trunk as possible, the wound is smoothed off and shaped to the contour of the trunk by means of the chisels and the rasp. The bark is tapered toward the center of the cut with a sharp knife. It should be possible to pass the hand over the cut in any direction without feeling a decided bump. All cut or scored spots are then given a coat of liquid roofing cement or paint to protect the open wounds. The roofing cement has the advantage of being weatherproof and much thicker than ordinary paints. If the work is properly done, the bark will grow in over the cut and often cover it entirely.

The lower left-hand illustration shows the result of leaving stumps when large branches are cut off. When all of the decayed wood had been removed from this Bellefleur apple tree, a thin shell of green wood and bark, not more than ¾ in. thick, was all that was left. The hole extended nearly a foot below the surface of the ground and went clear through the bottom of the trunk. That the tree could survive seemed impossible. Nevertheless, I braced the tree and filled the hole with a well-tamped mixture of four parts of sand and one part of Portland cement. A strip of tin was tied around the tree near the ground to serve as a form until the cement had set sufficiently to support its own weight. The tin was then removed and the filling was smoothed and trimmed to its final shape. After several days, a heavy coat of roofing cement was applied. Not only did the tree survive, but it bore four boxes of apples last season.—CHESTER LAWRENCE.

Apple tree with cavity caused by neglecting to doctor large stumps after pruning, and the filling a year later

* * *

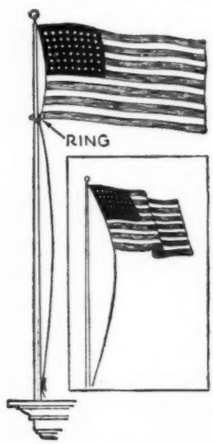
A HIGH-GRADE paintbrush on which you do not care to use a caustic brush cleaner can be soaked in amyl acetate ("banana oil"), washed well in alcohol, and combed with a stiff wire brush to remove every trace of scum.—O. B.



WATCH REGULATED WITH AID OF TOOTHPICKS

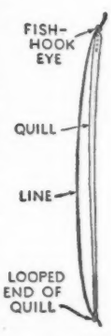
YOU can regulate a watch or clock with greater accuracy by the use of two toothpicks. Ordinarily the regulating lever or hand is set towards "slow" or "fast" without attention to the exact distance it is moved, but it is better to move the hand one half division or less at a time. Place the point of a toothpick on the scale about a half space away; then use the other toothpick to push the hand until it is stopped by the first one. Continue doing this on succeeding days until the watch or clock is keeping time accurately.—K.M.

RING HOLDS BOTTOM OF FLAG CLOSE TO POLE



AS ORDINARILY rigged, a flag, especially if large, has a tendency to pull away from the flagpole at the bottom. The higher the pole and the stronger the wind, the more this is noticeable. It can be corrected, however, by attaching a wire or light metal ring to the lower corner of the flag in such a way that the ring will slide up and down the pole with the flag.—N. D.

NOISELESS FLOAT MADE FROM LARGE QUILL

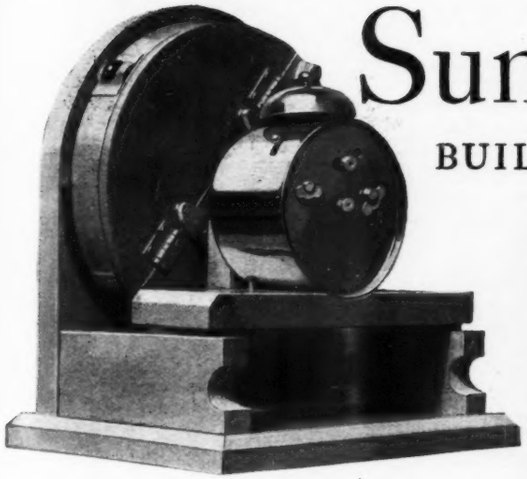


IF YOU want a float that is noiseless to loop on your line when you are fishing for sunfish, make one out of a large turkey or eagle feather. Just trim the quill down smooth, bend the small end into a loop, and tie it as shown. Cut the shank off a small fishhook and stick this into the big end of the hook to form an eye. The job is then finished unless you want to paint the float some bright color. You will find that it is a remarkably good float and makes no noise when you give the line a jerk.—FRED CORNELIUS.

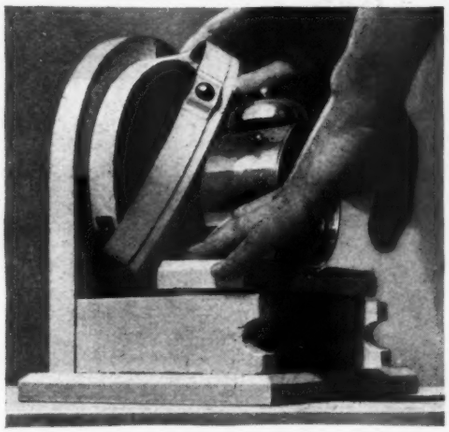
Sunshine Recorder

BUILT FOR A DOLLAR AND A HALF

By Edwin M. Love



The instrument consists of a stationary drum carrying a strip of blueprint paper (shown at right) and a clock that turns a revolving cover with a glass marble set into it



DAILY the sun stores water power in mountain reservoirs for our use. It puts food energy in grains and fruits, and vitalizes life processes in the bodies of men and animals. For this reason, weather bureaus measure the quantity and quality of sunlight; and you back-yard observers should add a sun meter to your equipment.

A recorder like that illustrated will register total sunshine and indicate when clouds hide the sun, yet it is easy to build and need not cost more than $1.50 for materials, including the clock. It consists of a drum carrying a strip of blueprint paper, a revolving cover with a glass marble for a lens, and the clock.

The wooden drum, which is ¾ in. thick and 7¼ in. in diameter, is bored out in the center to clear the nut that holds the cover shaft. The drum is screwed centrally on the rounded end of the standard, which is butted against the base and held with screws from the bottom. The two brackets have curved notches in their front ends so they may be attached with screws to the base, as shown.

If the clock has legs, unscrew them and hollow the wooden base to fit, using machine screws for clamps. If there is a metal base, put the screws through it; but in this event the wooden base will have to be notched into the brackets.

The cover for the drum is a tin lid, such as one from a dust-mop can, with a back of three-ply stock. The back is cut at 45 deg. at the hinge joints to keep out light, and nailed to the metal lid with small brads that are clinched inside. Bore the shaft hole small enough for the shaft to thread into it.

Drill rod is best for the shaft, since it is ground to size and can run in a bearing with little play. Thread it, run on a nut, screw it into the drum cover, and clamp with a nut.

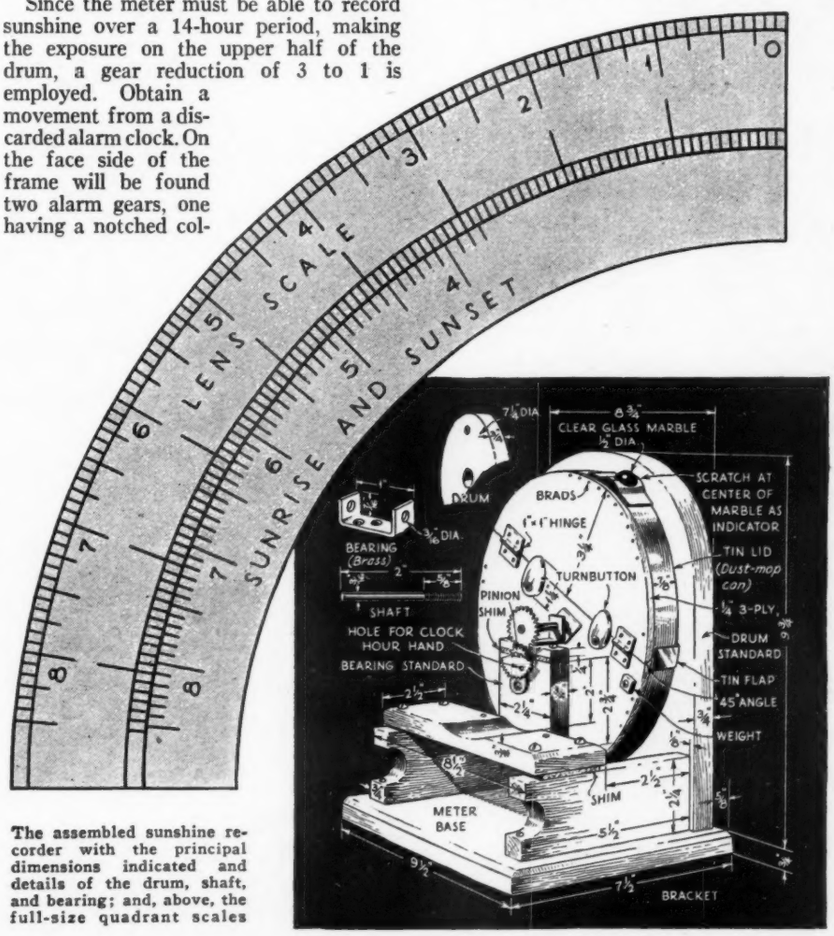
Mount the marble in the middle of the flange of the hinged part of the cover. Drill a ⅜-in. hole for it to rest in, and a similar hole in a ¾ by 1½ in. tin strip to be soldered on top. The side gaps around the marble must be puttied to keep out the light, while the joints in the tin flange at the hinge line should be protected with tin squares soldered to the segment as shown. Press the marble mount in or out to bring the center of the marble within ⅜ in. of the drum, an arrangement that allows for some variation in the size of the marble.

The drum-cover bearing assembly is mounted on the upper end of a wooden block, which in turn is screwed to the base. A wooden shim may be interposed as shown, if necessary, to aid in making an accurate adjustment.

Since the meter must be able to record sunshine over a 14-hour period, making the exposure on the upper half of the drum, a gear reduction of 3 to 1 is employed. Obtain a movement from a discarded alarm clock. On the face side of the frame will be found two alarm gears, one having a notched collar, the other a pinion and spur pivoted on a short spindle riveted to the frame. Remove the collar gear and drive out its center. Withdraw the cotter pin from the spindle, slip off the gear, and cut loose a section of the frame to screw on the mounting block. Drive brads at each side to prevent swiveling when the gears are mounted with the spindle centered ⅛ in. above the standard.

Bend a U-bearing from a brass strip. The two holes for screwing it to the base block are drilled near one end to project the bearing toward the drum.

When assembling the meter, adjust the end play in the drum-cover shaft by putting washers on it, and solder the spur gear to the end. Balance it with a button of solder on the flange opposite the marble. Then screw *(Continued on page 80)*



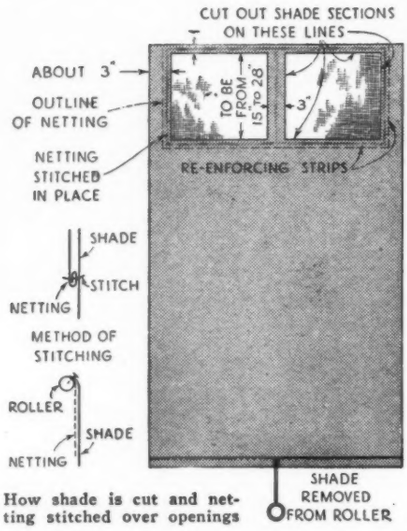
The assembled sunshine recorder with the principal dimensions indicated and details of the drum, shaft, and bearing; and, above, the full-size quadrant scales

VENTILATED SHADE LETS WARM AIR OUT

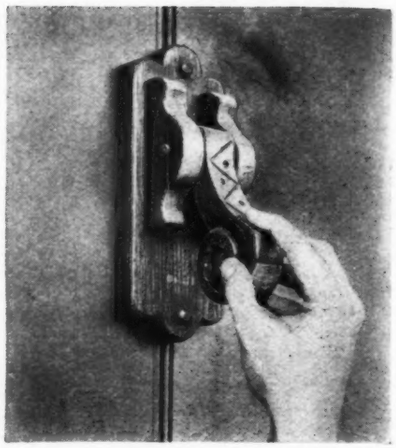
Window shade with netting at top so that a better circulation of air may be maintained

A FULLY or even partly drawn window shade presents a barrier to the escape of hot, dry air from an overheated room. This difficulty can be overcome and one's privacy preserved by inserting a ventilator of mosquito netting, or similar mesh, in the upper part of the shade as illustrated. The netting can be obtained in various colors to match almost any shade. Stitch the netting on with reënforcing strips, then lay a dry cloth over the ventilator and iron it flat and smooth. Retack the shade on the roller with the netting on the inside.

During the day, when the shade is not drawn lower than the middle of the window, the ventilator is invisible. At night the shade is drawn to within a few inches of the bottom of the window so that cool air can enter there and hot air can escape at the top through the partly open upper sash.—LAWRENCE N. OLSEN.



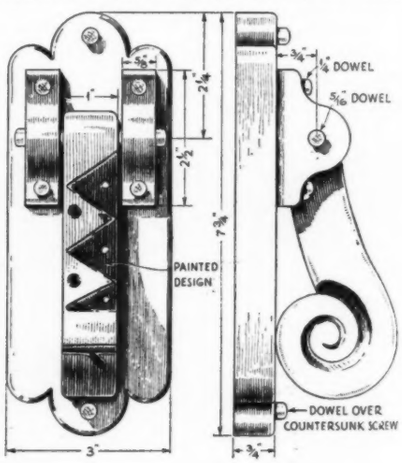
How shade is cut and netting stitched over openings

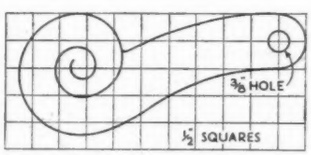


WOODEN DOOR KNOCKER FOR SUMMER COTTAGE

HERE is a cottage door knocker, made entirely of wood, that is particularly appropriate for a shore or mountain home. The base or panel is of ¾-in. oak or other hardwood, and the knocker is cut from 1-in. stock and carved in a spiral scroll. It should be bored at least 1/16 in. larger than the dowel upon which it swings, so that it will not swell tight in wet weather. The screw heads are concealed with short pieces of dowel.

The original knocker has a weathered-oak finish with a touch of color here and there to add to the decorative effect.—H.S.



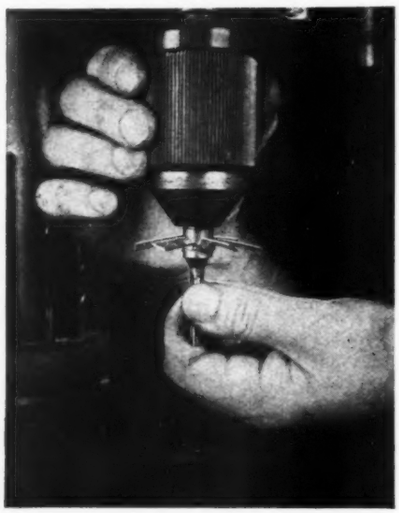


Front and side views of the knocker, and a layout to aid in marking the scroll before carving

FAN ON ROUTER BLOWS AWAY THE CHIPS

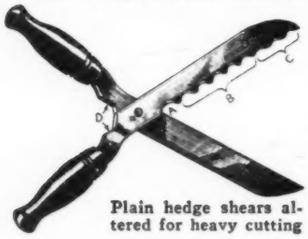
WHEN routing wood on the drill press, a blower is as useful as it is on the scroll saw. One can easily be made in the form of a tiny circular fan, which is slipped over the shank of the router bit. Clear, thin celluloid is used for making the fan because it does not interfere with vision, and also is harmless in case the hands should accidentally touch the blades.

The tube is made from a ½-in. strip of celluloid; the blades are ¼ by 1 in. and bent over for ⅛ in. at one end. Use a cellulose type cement, reënforcing the blades with large drops as shown below. You need not fasten the fan to the bit.



Cementing the celluloid fan blades to a ring of celluloid made to fit the shank of the routers

NOTCHED SHEARS TRIM TOUGH HEDGES



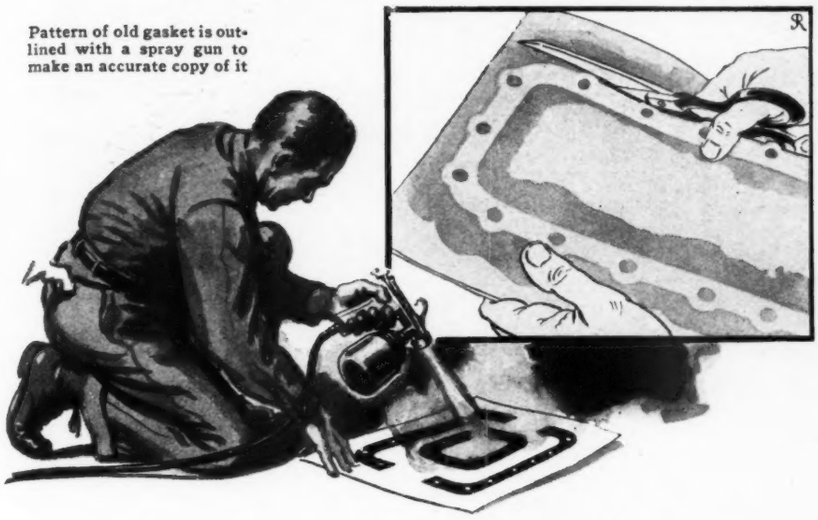
Plain hedge shears altered for heavy cutting

COARSE, thick, tough hedges may be trimmed with less effort if a number of notches are ground in one blade of the hedge shears as shown.

Many shears have the slot marked *A* already ground in—about 1 in. across and ⅜ in. deep. It is ground at such an angle that it has a very sharp cutting edge all around. Grind slots *B* in the same way, but make them ¾ in. long and ¼ in. deep. The slots marked *C* are then ground in scallops. At *D* the metal must be ground off a little.—ROY SPAFFORD.

Short Cuts for Car Owners

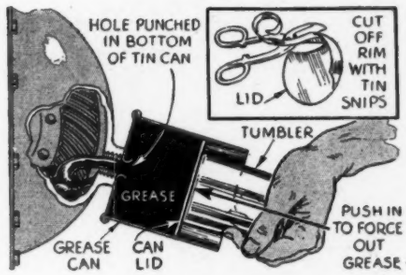
Seven Ideas from Readers That Will Help You Keep Your Automobile In Shape



Pattern of old gasket is outlined with a spray gun to make an accurate copy of it

Spray Gun Simplifies Gasket Making

IF YOU have a paint spray gun handy, it can be used as a means for making accurate copies of gaskets. Simply arrange the old gaskets on a sheet of new gasket material, fill your spray gun with a thin solution of paint, and spray the entire surface as shown above. When you remove the old gaskets, you will have accurate stenciled copies of their outlines to serve as a guide for the cutting. This is a particularly convenient method when a variety of gaskets must be made.—E. M.

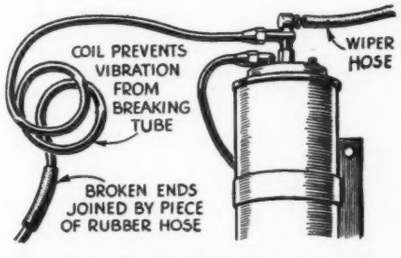


Filling a Differential

TO FILL a car's differential with grease from a can, remove the lid from the can and cut off its outer rim to form a disk. Then punch a hole in the bottom of the can and push the disk into the open top of the can. Finally, hold the can so that the hole in its bottom coincides with the differential filler hole, place a drinking tumbler against the disk, and push. The pressure will force the grease out of the hole in the can, and into the differential filler hole, just as it does in a grease gun.

Improving the Gas Line

VIBRATION from rough roads recently broke the gas line from the vacuum tank to the manifold on my car. When a replacement suffered the same fate, I experimented and found two ways of making a lasting repair. The pipe can be replaced with a new section bent into a coil to ease the shocks, or the two broken ends can be joined with a piece of flexible rubber tubing.—R.L.S.



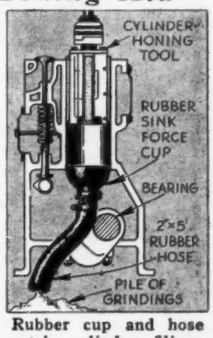
To keep vibration from breaking the gas line, coil it or insert a section of flexible tubing

Handy Oiler for Wheels

TO SIMPLIFY the problem of servicing independently sprung wheels, one wide-awake service man invented the handy oiler illustrated. It consists of a wide-mouthed jar having a screw cap fitted with a spout, a vent, and a graduated measuring stick. In use, the oiler can be handled from the rear of each wheel unit, the wheels being cramped but not removed. The graduated stick measures the amount of liquid used and makes it easy to approximate the cost—L. K.

Cylinder-Honing Aid

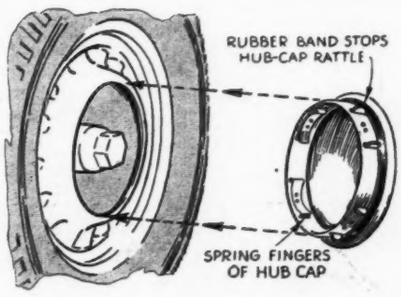
THE simple cup-and-hose arrangement shown prevents metal filings from reaching the crankshaft of a motor when a cylinder honing tool is being used. It is made by fastening a length of rubber hose to a plumber's force cup.—R. D.



Rubber cup and hose catch cylinder filings

Rubber Band Silences Noisy Hub Caps

ALTHOUGH the large, disk-type hub caps used on most modern cars are designed to fit tightly in the wheel recesses, dents and rough handling often cause them to loosen up and rattle. They can be silenced, however, by making use of a quarter-inch-wide band of rubber cut from an old inner tube. Simply remove the hub cap, stretch the rubber band, and place it over the projecting spring fingers on the inner rim of the cap in such a way that it will serve as a washer between the hub cap and the wheel.—G. A. I.



Mask Protects Motor Head

WHEN a motor is being repaired, carbon scraped from the tops of the pistons may fall into the water jacket and cause trouble. To prevent this, I use a simple sheet-metal mask cut to the same outline as the cylinder-head gasket, but without the water-jacket openings. Laid in place over the motor, it covers the water holes and seals them against dirt and scrapings.—E. T. G., Jr.

STEAM BOILER

FOR USE WITH A MODEL ENGINE

By

C. K. *Fankhauser*

Complete power unit ready for use and, above, brazing the tubes with silver solder

ALTHOUGH designed to operate the model steam engine described in a previous issue (P.S.M., May '35, p. 72), this boiler will be found satisfactory for use with any small steam engine. It is particularly suitable for installation in model steamboats of the slower type where a high-pressure flash steam system is not required. Among its advantages are simplicity of construction, low cost of materials, a unique and efficient heating unit, and safety.

Materials. One piece seamless brass tubing 2½ in. in diameter by 6 in. long. Six feet seamless brass tubing of ⅛-in. inside diameter. One piece copper or brass tubing ½ in. in diameter by 6 in. long. One piece 1/32 in. thick sheet brass, 6 by 8 in. for boiler ends and fuel tank. One 1-lb. cocoa tin of the type shown for boiler housing, ¼ lb. plastic asbestos, and a little asbestos wool. The safety valve, filler plug, and other small parts can be made from scrap material.

Making Boiler. Square and smooth ends of 6-in. length of 2½-in. brass tubing. Cut two disks of heavy sheet brass to fit snugly in ends.

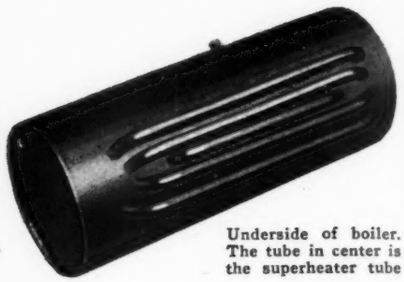
Anneal ⅛-in. tubing by heating to a dull red and quenching in water. Take the entire length of tubing and, leaving enough stock to hold onto with a pair of pliers, make the first bend. Then, using the hands only to hold the tubing, make the second bend the proper distance from the first to form one of the water tubes. Saw off and trim to exact length.

As shown in cross section of boiler, the superheater tube has its open end inside boiler about ¼ in. from the top. The tube then passes down through bottom of boiler and along underside between the water tubes, enters boiler again at opposite end, and passes up through top.

After all tubes have been formed and ends filed square and smooth, spot the ten holes on bottom of boiler into which the tubes are to be soldered. Drill holes a trifle undersize and file ends of tubes to a snug fit. Ends of water tubes should project into boiler about 1/32 in. Put tubes in place and bind securely with iron wire. If you have access to a brazing torch, the soldering should be done with silver solder. However, since the boiler operates at low pressure, a careful job of soft soldering will serve.

Next solder in the end plates, which should fit closely. First spot-solder them at three or four points around the edge, placing them about ⅛ in. in from ends of boiler. Using light hammer blows while rotating the boiler on an anvil or iron block, carefully turn ends of boiler in over end plates.

Filler Plug and Safety Valve. The filler plug is simply a screw plug, seated in a short length of drilled and tapped brass rod soldered in top of boiler. If you do not care to buy a safety valve, a simple one can be made of scrap brass as shown. By varying tension of spring, the valve can be adjusted to pop at the desired pressure. The writer attached an auto tire gauge to the boiler outlet and adjusted safety valve to pop at 25 lb.



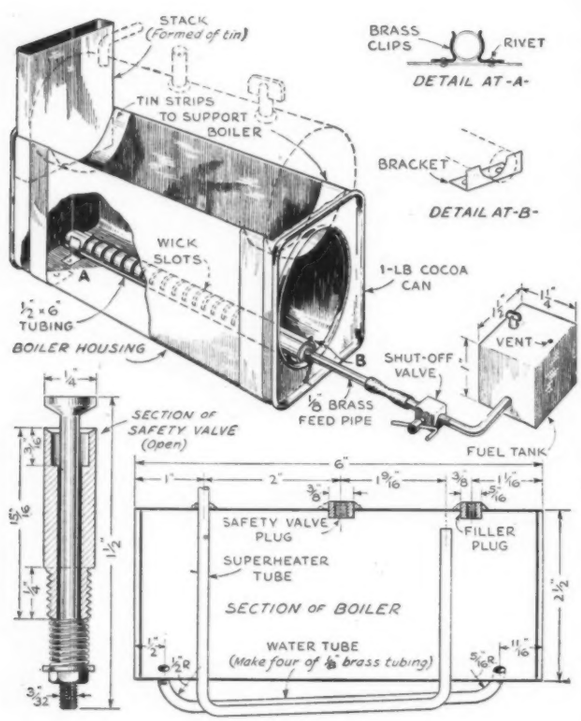
Underside of boiler. The tube in center is the superheater tube

Housing. The 1-lb. cocoa can is exactly the right size, but light gauge sheet iron can be used if desired. Carefully cut out one entire side of the cocoa tin. Then, with ¾-in. strips of tin or light brass, form straps to support boiler so that it drops half way into can. It will be found that the can is ½ in. longer than the boiler. This space is left at the rear and serves as an opening for the stack, which is formed of tin. The stack should run from bottom of boiler to any desired height.

Strips of brass or tin may then be fastened to bottom of boiler housing for mounting purposes. Next rivet in place the clips or supports for burner as shown.

After assembling boiler, stack, and housing, bind boiler firmly in place with copper wire. Then cover entire assembly with a ¼-in. layer of plastic asbestos.

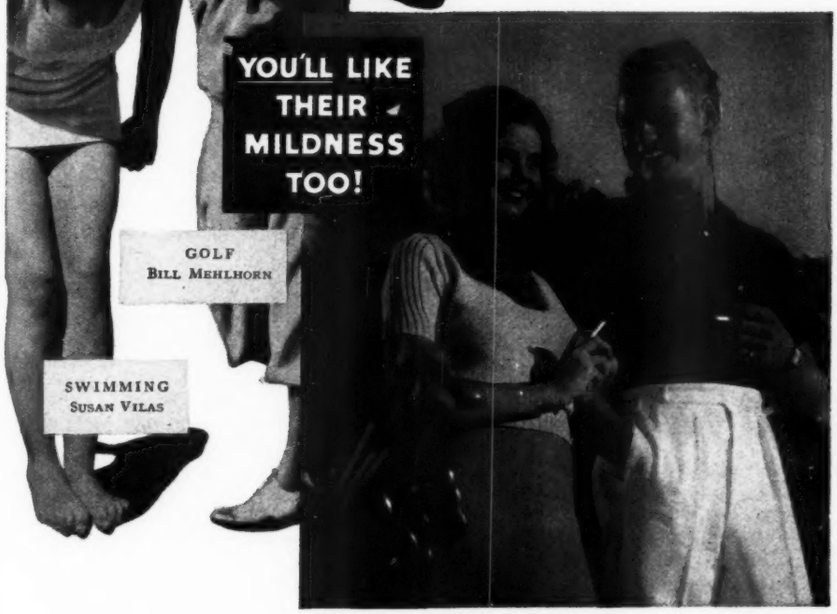
Burner. Take a piece of ½-in. brass or copper tubing and with a hack saw make eighteen cuts ¼ in. apart, each halfway through the tube. Close one end of tube with a plug. Cut a plug to fit other end and drill a hole through plug to receive a piece of ⅛-in. brass tubing. Take a piece of ⅛-in. tubing about 10 in. long and, starting at one end, drill sixteen or eighteen holes ¼ in. apart with a No. 60 drill. Insert this fuel supply tube in burner tube as far as it will go; then pack unit with asbestos wool. Slip plug over protruding end of fuel supply tube, slide it into place, and crimp burner tube *(Continued on page 87)*



The general set-up, sectional drawing of boiler, and the safety valve

The boiler and cocoa-can housing assembled preparatory to covering them with asbestos

Read what athletes say about Camels



KEEPING IN "CONDITION" means much to every one in enjoying life more. Smoke Camels, the cigarette athletes say never upsets the nerves or disturbs the wind.

The fact that athletes smoke Camels freely shows how mild Camels are. For athletes put mildness first. As Carl Hubbell says: "Camels are so mild that no matter how many I smoke they never get my wind or ruffle my nerves."

Here's Bill Mehlhorn, the veteran golfer: "From years of experience, I know that Camels will never get my wind."

And George M. Lott, Jr., dynamic tennis star: "Camels never take the edge off my condition or get my wind, because they are mild."

Sam Howard and Susan Vilas, among the diving and swimming champions, and George Barker, the track star—all agree that Camels do not disturb their nerves or wind.

Why this mildness, approved by athletes, is important to you!

Because Camels are so mild...made from more costly tobaccos than any other popular brand...you can smoke all you please. Athletes are agreed that Camels do not jangle the nerves or get the wind. And you'll find that your taste never tires of their appealing flavor.

SO MILD YOU CAN SMOKE ALL YOU WANT

Camels

COSTLIER TOBACCOS!

• Camels are made from finer, MORE EXPENSIVE TOBACCOS —Turkish and Domestic—than any other popular brand.

(*Signed*) R. J. REYNOLDS TOBACCO COMPANY, Winston-Salem, N. C.

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MUTT AND JEFF NEARLY LOSE THEIR JOBS -
WELL, JEFF-- WE CAME NEAR BEING OUT OF WORK!
WHAT, NO MEAL TICKET?
NO FOOLIN'- OUR BOSS HAD SOME ACCIDENT!
GO AHEAD - TELL ME HE BROKE A PENCIL!
STUPID-HE HAD A BLOW-OUT AND HIS CAR DID HAND SPRINGS!
A BLOW-OUT THAT'S BAD NEWS!
ARE WE LUCKY HE DIDN'T GET KILLED!
WHEW! WHAT A CLOSE SHAVE!
Fisher
"I'LL NEVER JOKE ABOUT A BLOW-OUT AGAIN" says BUD FISHER
Famous Creator of Mutt and Jeff

PLAY SAFE WITH SILVERTOWNS!

"MANY a time I've joked about a blow-out," says BUD FISHER, "but never again! On the way to Saratoga for the races, my car was completely overturned due to a blow-out. I was compelled to spend several months in the hospital, during which I had plenty of time to think of how important a part tires play in the safety of motoring. I'm not taking any more chances. I've equipped my car with Goodrich Silvertowns."

At today's high speeds, the *inside* of the tire gets as hot as boiling water. Sooner or later, this internal heat must escape. And it does. A tiny blister forms on the inside of the tire—between the rubber and fabric!—This blister grows bigger—BIGGER, until, BANG! A blow-out!

To protect motorists, GOODRICH engineers invented the amazing Life-Saver Golden Ply—which resists internal tire heat and protects against these treacherous, *high-speed blow-outs.*

And examine the husky-cleated tread on these big Silvertowns. Then you'll see why they keep your car "straight-in-line" on wet slippery roads and give you months of extra "trouble-free" mileage! Equip your car with GOODRICH Safety Silvertowns. *They cost not a penny more than other standard tires.*

Copyright, 1935, The B. F. Goodrich Co.

The NEW Goodrich *Safety* Silvertown
WITH LIFE-SAVER GOLDEN PLY

DO YOUR SPARK PLUGS MATCH YOUR DRIVING?

(Continued from page 54)

shiny blue sedan, and a man waiting by it.

"Well!" he exclaimed, "Old Fussbudget Maxon's waiting for us. Probably got a bumblebee stuck in his radiator, or something just about as important."

"Say, Gus!" Maxon called out, even before the service car stopped rolling. "This motor doesn't seem to idle as smooth as it should. Listen a minute and you'll hear it miss a beat now and then. Would you look it over?"

GUS went through the same routine in testing Maxon's motor that he had followed in analyzing Armstrong's car. Watching him, Joe noted, however, that in this case the spark-plug points were exactly the right distance apart and the breaker contacts opened precisely the amount the motor manufacturer recommended. The coil gave a strong, nearly white spark, instead of the thin blue one Gus had drawn from the coil in Armstrong's car.

Therefore, Joe was surprised at Gus's next move. The veteran mechanic took the end of a screw driver and bent open the plug points until they were fully fifty percent farther apart than the manufacturer specified. He put them back in the cylinders and Maxon started the motor. After it warmed up, it idled with a steady ticking that brought a smile to Maxon's face.

"I'll be jiggered if I can figure that out," Joe Clark remarked after the customer had driven off. "First, you fix a miss in Armstrong's red speedboat by pushing the spark plugs close together, then you fix a miss in Maxon's bus by spreading them so far apart you could almost jump between them yourself—and darned if it doesn't work right in both cases! What's the answer, Gus?"

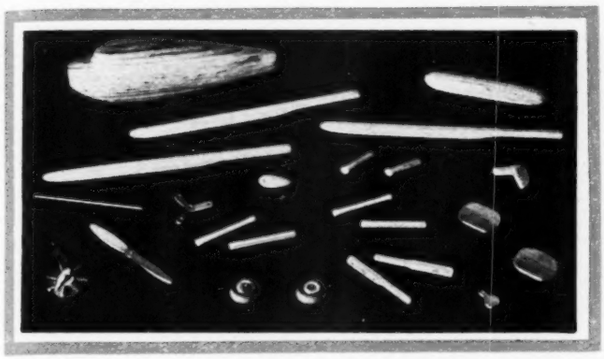
"Simple enough, if you know what makes the spark and what it's supposed to do," Gus grinned. "In the first place, the plug-point gap spacing the makers recommend is no sacred camel. The motor will run with it bigger or smaller than specified. As a matter of fact, a slightly wider gap will give better performance at all speeds, when everything else about the ignition system is in perfect shape. The makers have to allow for the fact that the average car owner doesn't keep his car that way for long. Carbon collects in the cylinders and raises the compression, which has the same effect as widening the plug gaps. The timer contacts get burned and rough, and that makes the spark weaker. Coils aren't absolutely uniform; some are weaker or stronger than the average—or, if they are right to start with, age doesn't make them any better. That goes for condensers, too. Spark-plug wires leak current, and so on.

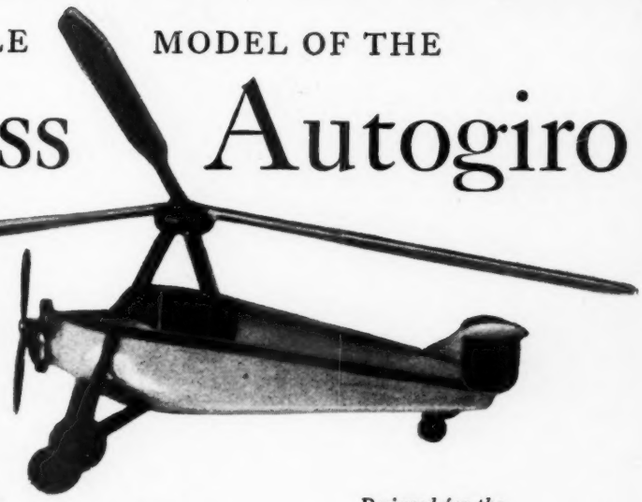
"A MISS that is caused by too-wide plug gaps," Gus continued, "or by something wrong in the ignition system that weakens the spark, always shows up first at high speed. That's because when you have the throttle open, the compression is high and at the same time the breaker contacts don't make contact long enough to get the full flow of current through the coil. That was what was the matter in Armstrong's case. And, as you know, he's a speed hound. So if you give him ignition that won't miss at high speed, he's satisfied.

"On the other hand, Maxon would throw a fit if he ever saw the speedometer hit forty. Besides that, he's a bug on gas economy and smooth running at low speed. You don't have to worry about his ignition cutting capers at high speed; he'll never get going fast enough. You can open up the plugs quite a way, and the longer spark gives better ignition when the mixture is thin and the compression is low because the throttle is nearly closed."

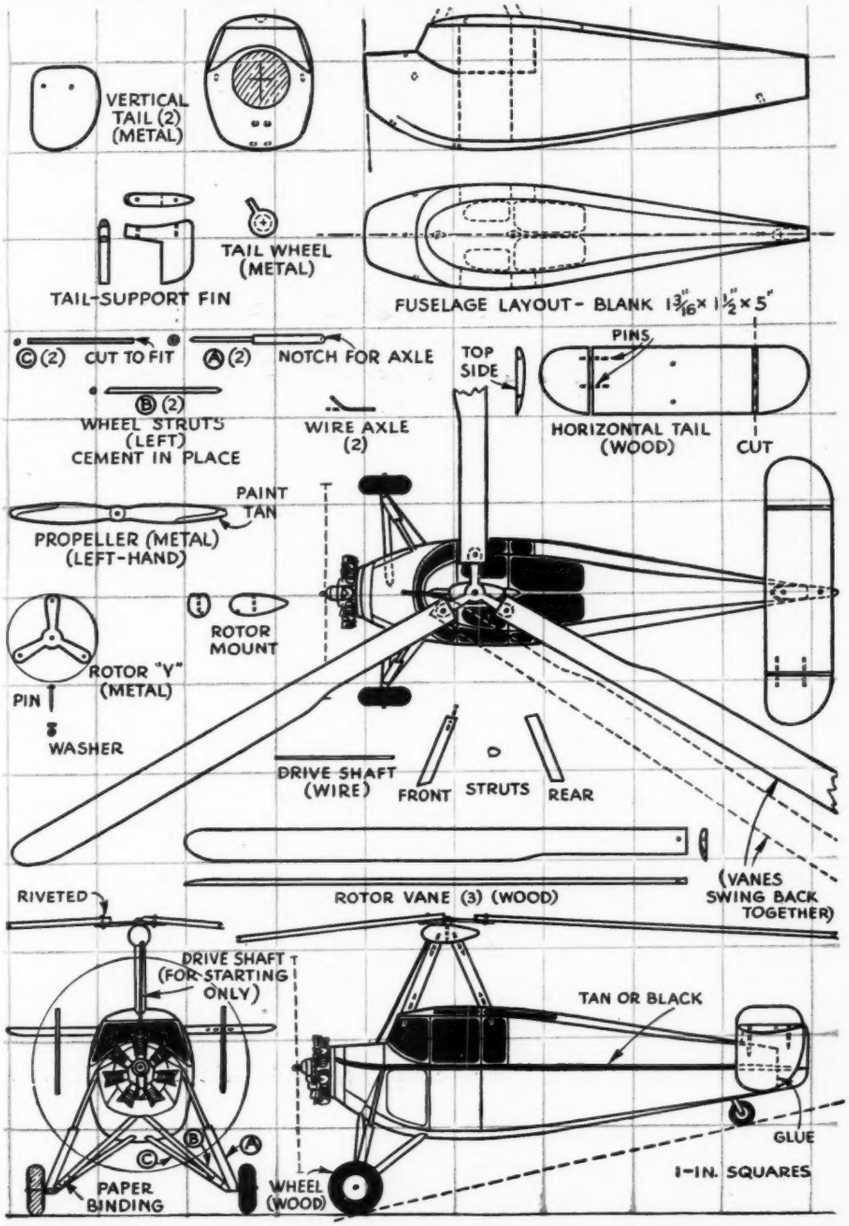
HOW TO MAKE A SOLID SCALE MODEL OF THE

New Wingless Autogiro





The completed model, the twenty-four units from which it is built, and, below, the drawings on 1-in. squares for easy enlargement



Designed for the
POPULAR SCIENCE
MODEL-OF-THE-MONTH CLUB

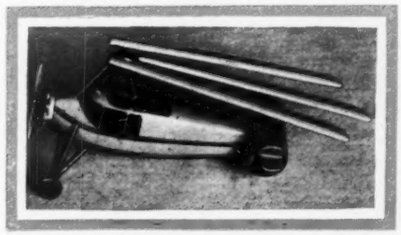
by
Donald W. Clark

AS A VARIATION from our usual miniature ship models, we are offering plans for the latest type of wingless autogiro as the August project of the Popular Science Model-of-the-Month Club. It is an easily made but unusually interesting little model by a contributor whose airplane designs have been appearing in the Home Workshop Department for many years.

The model is not quite 6 in. long over all, except for the rotor vanes. It is built to the scale of 3/8 in. equals 1 ft. on the full-sized autogiro. Only twenty-four units are required if the engine is counted as a single part. The engine itself is built up of twenty small pieces of wood and metal.

Make the fuselage from a block of soft pine (or balsa wood, if you prefer) 1 3/16 by 1½ by 5 in. The squares on the drawing will aid in laying out the full-size outlines. To those accustomed only to building simple ship models, the shaping will be somewhat easier if a few cardboard templates are prepared to aid in getting both sides alike, just as in carving a ship-model hull. Study the front, side, and top views of the fuselage in the drawings carefully and compare them with the photographs before doing any cutting.

Once the fuselage is shaped, little difficulty will be experienced in making and fitting the remaining parts. Common pins are used to fasten the tail and the rotor-mount struts to the fuselage, and also for the turning point of the rotor. Bevel the ends of the landing gear struts and fasten them with glue. Small pieces of wire, bent as shown *(Continued on page 79)*

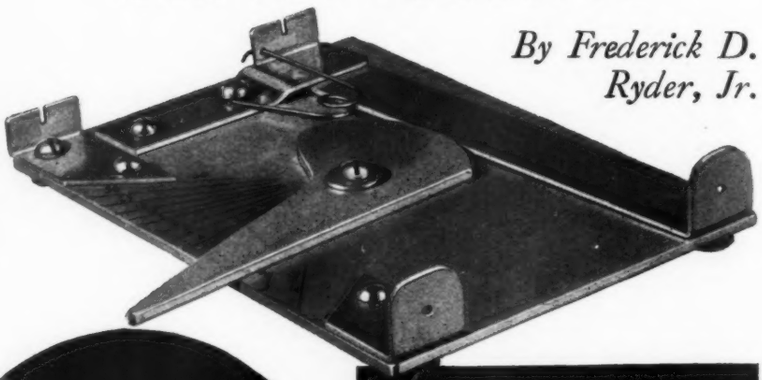


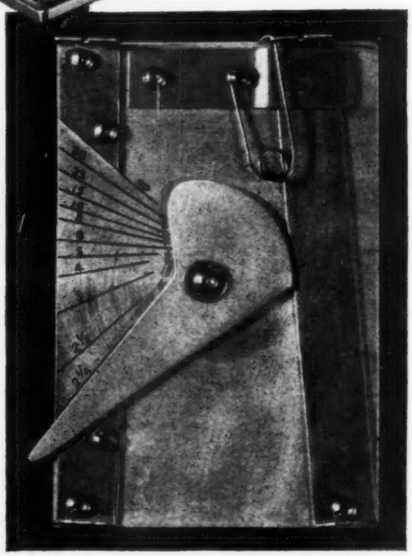
Just as in the real autogiro, the vanes of the model can be folded back over the body

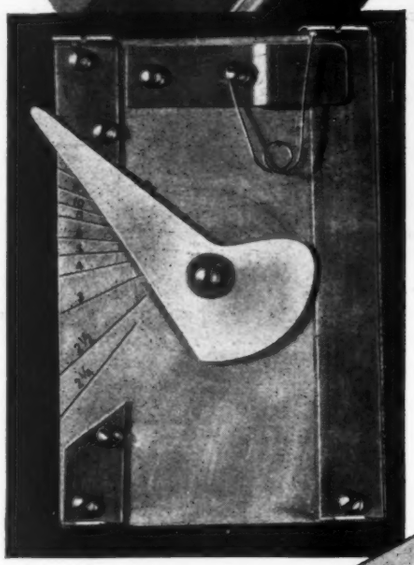
HOMEMADE
Range Finder
INSURES PERFECT CAMERA FOCUSING

By Frederick D. Ryder, Jr.

Although simple and inexpensive to make, this photographic range finder measures distances with accuracy

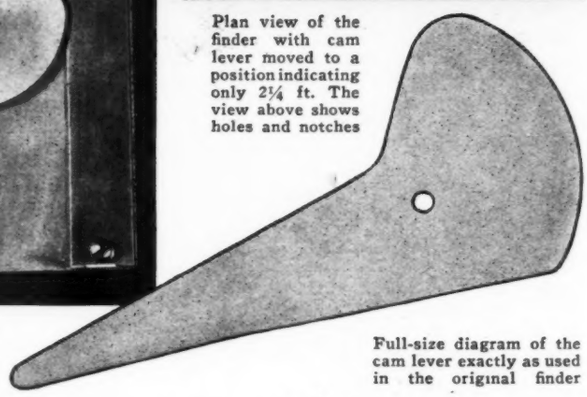






Here the lever has been set to the infinity mark. The wire spring and clip are shown in the circle

Plan view of the finder with cam lever moved to a position indicating only 2¼ ft. The view above shows holes and notches



Full-size diagram of the cam lever exactly as used in the original finder

THE two ever-present problems in photography, whether you are taking pictures with a still or a movie camera, are the matter of judging the right exposure and estimating the correct distance to the object being photographed.

The great latitude of modern film will take care of considerable error in exposure, but nothing can save your picture if you set the focus for the wrong distance on close-ups in poor light, when the lens must be used with a large diaphragm opening.

With the average roll-film camera or any of the ordinary types of amateur movie cameras, there is no way to focus the lens on a ground glass. You must, therefore, either guess the distance or actually measure it by pacing it off or using a tape or knotted cord. If you can afford it, another way to get your distances with accuracy is to purchase an optical range finder. Several types are made ranging in price from nine dollars up.

If you are handy with tools, a practical solution of the focusing problem is to build yourself the homemade range finder illustrated. You may find all the materials needed already available in your shop. If not, the cost will be trifling—say twenty-five cents at most.

In order to build this range finder and use it effectively, you must understand in a general way the principle on which it operates. A word of warning: Do not attempt to build the range finder unless you have normally good two-eyed vision. If one eye is defective or very much weaker than the other, you will not be able to use a range finder of this type. The matter of whether you do, or do not, wear or need glasses is of no importance at all.

When you look at an object, your eyes focus on it, and the two lines of sight from your eyes form two sides of a greatly elongated triangle with the distance between your eyes as a base. When you look at an object a long way off—the moon for example—the lines of sight from the two eyes form only a tiny angle with each other; they are nearly parallel. On the other hand, when you look at a near-by object, they converge to form a very noticeable angle. In theory, therefore, you should be able accurately to estimate the distance to any object nearer than infinity by measuring the angle formed by the two lines of sight.

There is, however, an apparently insurmountable obstacle in the way of building simple range finders in large quantities. This obstacle is the variation in eye spacing among different people. It would be easy enough to make the peep sights adjustable for spacing, but the calibration in feet also changes with variations in eye spacing. In factory-built range finders, this trouble has been avoided by the use of delicately adjusted semisilvered mirrors and prisms that *(Continued on page 75)*

Check these features — check the price

36 exposures
Film spacer
Fast (f.3.5) lens
1/500 shutter
Compactness
Low price

Film comes in daylight-loading magazines—36 exposures without reloading. Pictures about 1 x 1½ inches—readily enlarged.

No overlapping pictures—no wasted film. Film automatically stops at right spot each time you wind—and an indicator shows the number of pictures you've made.

The big, precision anastigmat lens admits ample light for fast action pictures . . . lets you make candid pictures indoors under artificial light.

Exposures up to 1/500 second, accurately timed by the Compur-Rapid shutter. Eight other speeds, as well as "time" and "bulb," are also available.

Folds flat, no projecting front to make it bulky. Only 4¾ x 3 x 1½ inches over all. Unobtrusive spyglass finder always ready for action.

Sturdy, precision construction, highest quality throughout, yet it costs about half as much as other cameras of similar range. See it at your dealer's. Eastman Kodak Company, Rochester, N. Y.

Kodak RETINA

$57.50

EASTMAN'S FINEST MINIATURE CAMERA

THREE FILMS FOR KODAK RETINA

PANATOMIC . . . extremely fine-grained, designed especially for miniature cameras. Makes striking enlargements. Completely color-sensitive.

"SS" PANCHROMATIC . . . Has extra speed for difficult pictures. Ideal for snapshots at night with Mazda Photoflood bulbs, or for fast outdoor action.

SUPER X . . . In speed, this film goes much farther even than "SS." Fully panchromatic. The latest word in ultra-speed film.

Free **Complete details on the Retina as well as other miniature cameras.**

Write today—you'll want this free folder for your photographic library. Eastman Kodak Company, Rochester, N. Y.

Name_____

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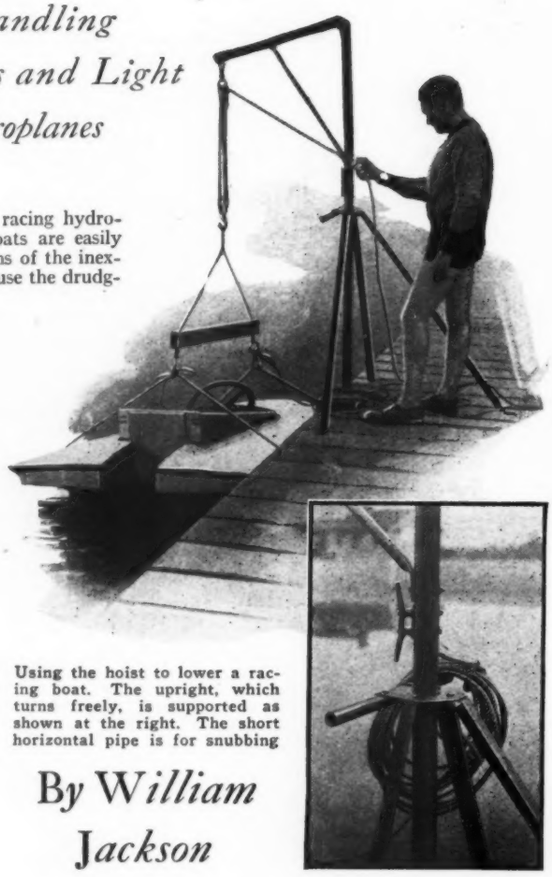
P.S. 8-35

Small Boat-Dock Hoist

Helps in Handling Outboard Motors and Light Racing Hydroplanes



Using the hoist to lower a racing boat. The upright, which turns freely, is supported as shown at the right. The short horizontal pipe is for snubbing

By William Jackson

OUTBOARD motors and racing hydroplanes or other light boats are easily raised to a dock by means of the inexpensive hoist illustrated. By its use the drudgery of attaching heavy motors is greatly lessened, the danger of theft is reduced, and excessive water absorption can be prevented in the case of racing hulls.

The hoist may be swung in a complete circle, while loads up to 200 lb. are lifted with ease. For heavier loads, two hoists should be used.

Most of the material may be purchased at the local junk yard, steel angles and pipe being the principal items. Angle irons from old beds are suitable for this purpose.

The 2-in. pipe upright and arm are hack sawed to length, and each is threaded on one end. The threaded ends are joined with a 2-in. pipe elbow.

To stiffen and support the arm, a piece of ½-in. pipe is cut to size, both ends are flattened and drilled, and the flattened ends are bent to fit against the arm and upright and fastened with two 2½ by ¼-in. machine bolts. Drill a ⅜-in. hole 1½-in. from the outer end of the pipe arm, and insert a 2½ by ⅜-in. eyebolt.

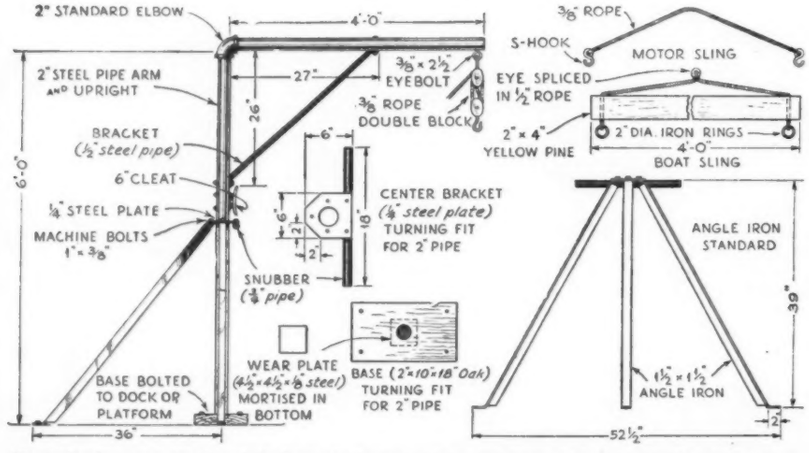
Cut the center bracket from 6 by 6 by ¼-in. sheet steel. The hole in the center should be large enough to allow the 2-in. pipe upright to turn freely. The hole is cut with chisel or torch, or drilled out, the edges afterwards being filed smooth. One inch in from the outer edge, ⅜-in. holes are drilled as shown so that the angle irons may be attached.

The 1½ by 1½-in. angle irons are hack sawed to size and the ends bent to fit the floor and the steel center bracket. Bolt the angles to the bracket with three 1 by ⅜-in. machine bolts. The other ends of the angle irons are either lag screwed or bolted to the dock.

A piece of ¾-in. pipe, 18 in. long, is drilled and bolted to the underside of the bracket with two 2 by ¼-in. machine bolts. This pipe is used to snub the rope when lowering heavy loads.

The base is a 2 by 10 by 18 in. oak block. A hole is cut in the center for the 2-in. pipe upright. Directly under the hole, a 4½ by 4½ by ⅛-in. steel plate is mortised flush into the bottom of the block and fastened with four 1¾-in. No. 10 flathead screws, after the plate has been drilled and countersunk. This plate provides a firm, wear-resistant rest for the bottom end of the upright. The block is bolted or lag screwed to the dock or platform.

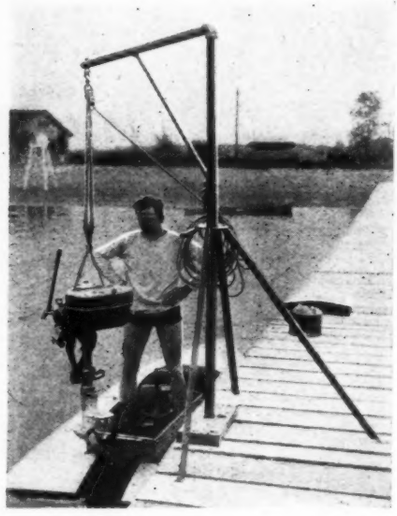
A 6-in. rope cleat is bolted to the pipe upright where indicated with two 3½ by ¼-in. machine bolts. To check and hold a load, the rope is tied to this cleat. A ⅜-in. diameter rope block and tackle is hooked to the eyebolt, and the hoist is ready for use. Simple slings for the boat and motor are made as shown.



The hoist is constructed mainly from steel pipe and angle irons, which can be obtained cheaply at a junk yard. Two pieces of steel plate also are needed for the center bracket and wear plate

List of Materials

Steel pipe: 2-in. (nominal inside dia.), 1 pc. 6 ft. long and 1 pc. 4 ft.; ½-in. (nominal inside dia.), 1 pc. 42 in. long; ¾-in. (nominal inside dia.), 1 pc. 18 in. long; 1 pipe elbow, 2-in.
Angle iron: 3 pc. 1½ by 1½ by 52 in.
Machine bolts: 3—1 by ⅜ in.; 2—2 by ¼ in.; 2—2¾ by ¼ in.; 2—3½ by ¼ in.
Steel plate: 1 pc. 6 by 6 by ¼ in.; 1 pc. 4½ by 4½ by ⅛ in.
Miscellaneous: 1 oak block 2 by 10 by 18 in.; 1—6-in. cleat; 1—2½ by ⅜ in. eyebolt; 1—⅜ in. dia. block and tackle set with 25-ft. rope.



A motor ready to be lowered. A drawing at the left shows the type of sling required

PLAYING CARDS PROVIDE SHIP-MODEL ORNAMENTS

WHEN looking for some small colored ornaments to glue on a Viking ship model, I discovered just what was needed on an old deck of playing cards. Since then I have used designs cut from playing cards to decorate various historic models. Borders, scrolls, heraldic designs, and a large variety of beautifully drawn and neatly colored decorations can be obtained in this way.—JAMES MOORE.

TURNING A MASONRY DRILL

THE next time you have to drill holes in brick or concrete by hand with only an ordinary hammer to provide the driving power, try using a pipe wrench to turn the drill. This will save your left hand from battered knuckles and a sore palm.—L. N. G.

UNIQUE LAMP TABLE

(Continued from page 59)

other end is cut after the various pieces are assembled.

The light sockets are made from two pieces of brass tube. One end is spread slightly over a piece of iron pipe held in the vise. The bottoms are made of two disks of brass slightly larger than the tubes. A piece of threaded fixture pipe about ⅜ in. long is to be soldered in the center of each disk after a hole is drilled to allow the wire to come through. Two more holes are drilled for screws to fasten the socket in place. The pipe is soldered to the bottom; then the bottom is soldered to the tube. The edges are filed, any surplus solder is removed, and the sockets are then polished.

List of Materials

No. of Pieces	Description	T.	W.	L.
1	Top (may be glued up)	½	13	17
2	Top molding	¼	¾	18
2	Top molding	¼	¾	14
1	Top cleat	¾	9	12
4	Legs	¾	1⅛	20¾
2	Feet	1⅛	3¾	15
2	Top cross arm	¾	1½	12
1	Vertical shaft	¾	1½	22⅝
1	Lower cross arm	1⅛	1⅜	8
1	Ratchet	¾	1⅜	4
2	Brass tube	1¼ dia.		1½

Wire and fixtures for two candlelights.

NOTE: All dimensions are given in inches.

The various pieces are put together for a trial assembly without glue. The ratchet is pivoted by a ¼-in. dowel, 4 in. from the top of the leg. The angle may be accurately drawn by holding the ratchet in place against the side of the leg and the shaft. The ratchet should work freely, and it may be necessary to file the hole in the leg a little. The shaft should raise freely through the top, and the lower cross arm must not be too tight on the legs. When everything works well, the stand is glued together with the lower cross arm in place.

The two cross arms are not glued to the shaft until the wires are in place. Use wire that has a tightly woven covering, the section of which is about ⅛ by ¼ in. Tape the joints sparingly or the wire will take too much room in the mortise. Two regular candle fixtures and covers to fit in the sockets are necessary to complete the wiring. Finally the cross arms are glued to the shaft.

The entire piece is smoothed all over with fine sandpaper or steel wool. Maple oil stain may be used, or a water stain made of ten cents' worth of potassium bichromate in a pint of water. Apply the stain and allow it to stand for an hour or more to dry. Water stain raises the grain, so it will have to be rubbed down with sandpaper or steel wool. Two thin coats of orange shellac are applied, the work being rubbed with steel wool after each coat. A coat of furniture wax completes the finish.

SKETCHING OVER PHOTOS

ACCURATE and artistic pen sketches can be made directly over an ordinary photograph and the image then bleached out completely, leaving only the pen lines. A rather light print on a dull-finished paper is the best to use. After drawing over it with waterproof India ink, soak it in water in which a very little potassium permanganate has been dissolved—only enough to color the liquid. Ten cents' worth of this chemical purchased at a drug store will bleach scores of prints. When everything fades but the India ink lines, remove the paper, which will be brown colored, and give it an ordinary acid-hypo fixing bath to restore its whiteness. Then wash it thoroughly to remove the hypo.—ROBERT E. WHITE.

LEGS
that take a thousand strides a minute
NEED AN OIL THAT COMES FROM
here!
Where Nature Stored PENNSYLVANIA GRADE CRUDE OIL
PHOTO BY BRUEHL

CONNECTING RODS in your motor are legs—fast-moving ones—that carry power from piston to crankshaft. Their smooth, hard bearings need the special lubricating qualities of Pennsylvania motor oils if they are to work with least friction and effort.

The special qualities of Pennsylvania motor oils benefit *every* vital part of your motor. And they save you both time and money. The rich "body" of Pennsylvania oils means more power for quicker pick-up. Their freedom from "drag" means less strain on the battery. Their thicker, stronger film prevents friction, overheating and repairs. The way they stay on the job saves adding extra quarts between changes. Their pure, stable chemical structure reduces sludge to the minimum.

The source of these special qualities is not a refining process, but a superior raw material—Pennsylvania Grade Crude. This naturally better material is produced in only one district—the area shown on the map. From this special crude are refined all the motor oils sold under the emblem of the Pennsylvania Grade Crude Oil Association. They are *better oils from the ground up.*

"New" oils, new processes, new claims, clamor for attention these days. True enough, improvements in refining are constantly being made. They benefit Pennsylvania motor oils as well as others. But they cannot create *basic* values in an oil. Those must come from the crude.

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Oil City, Pennsylvania
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PENNSYLVANIA
OIL
CRUDE OIL ASSOCIATION
PERMIT NUMBER .....
Made from the highest grade crude oil in the world

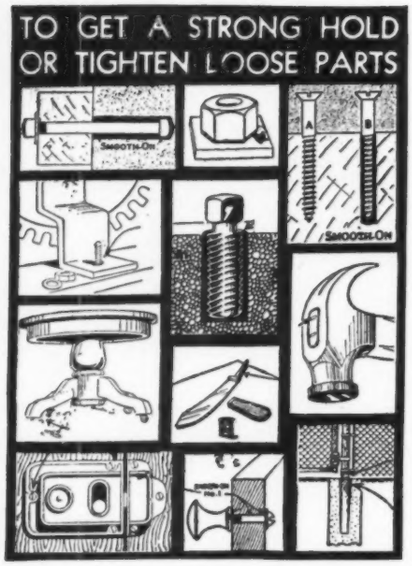
What This Emblem Means!

This emblem is the badge of membership in the Pennsylvania Grade Crude Oil Association. It is neither a brand, nor a pledge of equal quality among the brands using it.

You are protected when you buy oils sold under this emblem, because it assures you that (a) they are made 100% from Pennsylvania Grade Crude, and (b) they meet or exceed the high minimum standards set by the Association to assure proper lubrication of modern motors.

Safeguarding these assurances are: (1) the research laboratory of the Association at State College, Pa., (2) a national field force, and (3) each member's individual surety bond.

BETTER OILS FROM THE GROUND UP!



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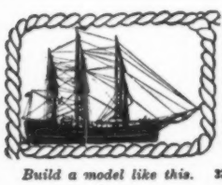

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ROY HANCOCK

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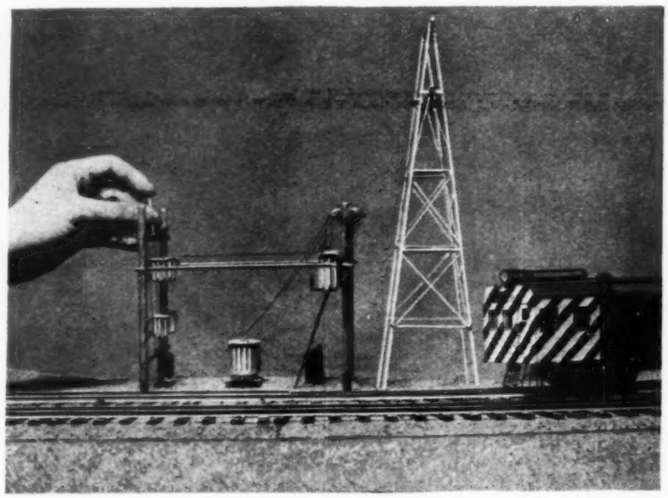
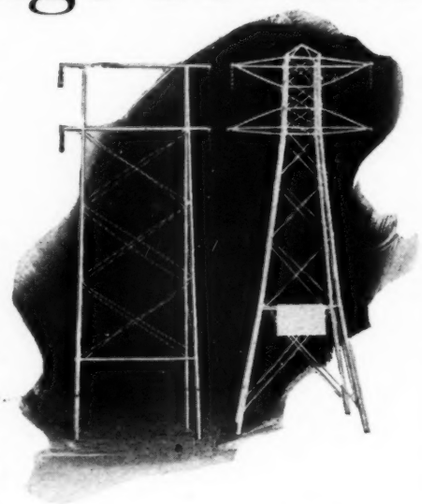


High-Voltage Towers

BUILT TO SCALE FOR MODEL RAILWAY LAYOUT

By Harry B. Fuge

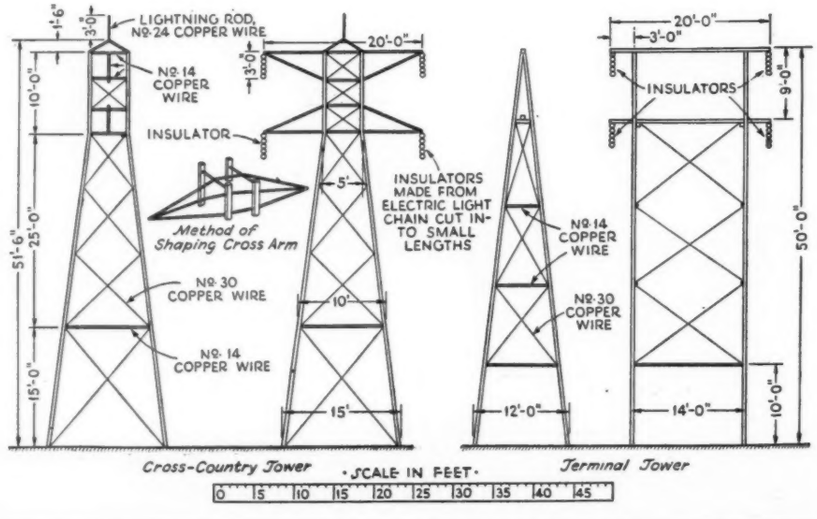


IF YOU have improved the scenic appearance of your model railway with a transformer station like that described in a previous issue (P. S. M., May '35, p. 106), it will now be necessary to construct the high-voltage power transmission line. Two types of towers are required. These are illustrated in the accompanying drawings and photographs. All dimensions are given full size to facilitate constructing the model to any scale desired.

The terminal tower should be placed 10 ft. (according to the scale used) from the high-tension side of the transformer station. The main supports and cross arms are constructed of 3/32-in. square brass, but the bracing is copper wire.

The number of cross-country towers you will need to build depends entirely on the size of your layout and the route you choose for the transmission line. They should be placed about 300 scale ft. apart.

To add realism, the four feet of each tower should be set in small blocks of plaster of Paris. These are painted gray to simulate concrete footings. Paint the insulators black and use heavy black thread for the cables, which should be slack enough to droop from tower to tower in graceful catenaries.



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Ingram's better shaves sound good to me. Let me try 10 of them, free.

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RANGE FINDER FOR PERFECT FOCUSING

(Continued from page 70)

allow one eye to see through two different openings.

Unless your eyes are exceptionally widely spaced, the base plate may be of aluminum at least 1/16 in. thick and 3¼ in. wide by 5 in. long. After this is prepared, cut two strips of sheet aluminum 1/32 in. by ⅝ by 5¾ in. Round one end of each piece and drill a peep hole in each with a No. 55 drill. Center each hole in the radius of the rounded end. A smaller hole will make the range finder hard to use in a dim light, and a larger hole will make the notch sights appear too fuzzy.

Now slot the opposite end of each piece with a slot ⅛ in. deep and 3/32 in. wide. It is more important that the notches be exactly alike in width and depth than it is to see that the dimensions are precisely as specified.

Next bend up ½ in. of the peep-sight end of each piece and 5/16 in. of the notched end so that the pieces, when bent, will be as long as the base plate. Fasten one of the strips to the base plate with four screws as shown. This is the left-hand one as the range finder is held in position for use. A portion of this piece is cut away later on.

Take up a position at a window or outdoors where you can obtain a clear view of objects at least 100 ft. away. Place the remaining strip containing the hole and notch in position on the base plate and carefully move it till you can see through both peep sights when your eyes are fixed on a distant object. Now move the peep end just a trifle so that the "peeps" are a trifle too near to each other to form a true circle when you look through them at a distant mark. This allowance is necessary, otherwise you will not be able to see through the peeps at close objects.

Carefully mark the position of the aluminum strip and with the part clamped in that position, drill the hole for the bearing screw as close to the peep end as you can get it and still have clearance for the screw head.

The next job is to cut out the cam lever from 1/16-in. aluminum sheet. The diagram shows this part full size.

RETURN again to the window and with the cam lever approximately in the infinity position (that shown in the lowest photograph on page 70), move it back and forth across the base plate while holding the movable sight member in contact with it until you find the position where the notches overlap and line up under a distant object sighted through the peep holes.

Mark the position for the cam-lever bearing screw and also draw a line across the fixed sight piece where the cam lever crosses it. This is the infinity position. After the bearing hole has been drilled in the base plate, you can mark the other line on which to cut the fixed sight bar to form the stop for the other end of the cam-lever movement.

The bearing screws for the cam lever and movable sight bar may be held by tapping the hole in the base plate and adding a lock nut underneath after the screw is adjusted to the right tightness; or a plain hole can be drilled straight through and after a nut has been adjusted to the right tightness, the end of the screw can be center punched. The first method is the better.

After the cam lever has been carefully fitted, with the remaining portions of the fixed sight bar acting as stops, cut another piece from 1/32-in. aluminum to form the clip that holds the end of the movable bar against the base plate, and also bend a spring to keep the end of the movable bar always in contact with the cam. This construction is clearly shown in the photograph in the circle. If no spring wire is available, a safety pin can be bent to serve the same purpose.

Before assembling the fixed peep sight and the fixed notch, it is desirable to file the screw holes in these pieces slightly oval so that trifling adjustments can be made later.

All that remains is to calibrate the range finder. This can be done by locating the positions of the cam lever that correspond with the distances marked on the focusing scale of your camera. Use a tape measure to get your distances accurately. Before you start, recheck the infinity setting for both fixed peep hole and notch, and readjust them, if necessary, by moving slightly. The oval holes will make this possible.

It is a good idea to mark the distance lines and figures first in pencil, and practice using the range finder at various distances and under different light conditions till you are sure you have the hang of it. Then the calibration can be rechecked and permanently scratched into the aluminum.

Do not be discouraged if at first you have trouble in lining up the notches without looking directly at them. Concentrate your attention on the object, and after a few trials you will find that the notches will line up without difficulty. After some use of the range finder, you will begin to notice a stereoscopic effect that seems to project the notched pieces out into space as a single piece that floats directly under the object on which it is set. When you get this effect, a slight movement of the cam lever actually seems to bring the projected sight notch nearer to, or farther from, you than the object, and it is easy to see when it is apparently exactly the same distance away. After you have become practiced in the use of this range finder, you will find it exceedingly accurate.

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YOU can double the pleasure you get out of your home workshop by using great care and discretion in choosing good projects to make. Whenever you are in doubt as to what to build next, consult our blueprint list. The following list gives a wide selection, but if you do not find exactly what you want, send a self-addressed stamped envelope for our complete list.

Our blueprints are each 15 by 22 in. and cost 25 cents a sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. Instructions alone are 25 cents each.

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NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

SHIP AND COACH MODELS

(Construction kits are available for some of these models. See page 85.)

Aircraft Carrier—U.S.S. *Saratoga* (18-in.) and flush deck destroyer (6¼-in.), *226-227-R* ..... .75
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Liner—*Normandie* (20¾-in.), *264-265* ..... .50
Liner—*Manhattan* (12-in. long), *204* ..... .25
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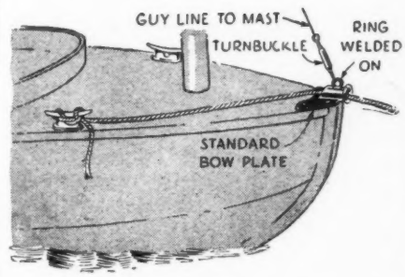
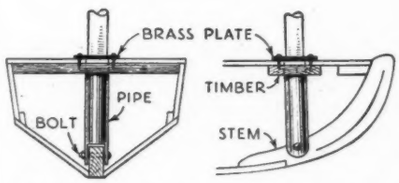
TWO IMPROVEMENTS FOR SMALL SAILBOATS



THE accompanying sketches illustrate two ideas I used in constructing the Olympic catboat from plans published in a previous issue (P. S. M., July '33, p. 57). The drawing above shows a standard type of bow plate with a brass ring welded on top to take care of the guy line to the mast. This arrangement greatly simplifies tying up the boat, as the rope is free to let the boat swing in any direction without fouling the guy lines. This can be used in any boat that is cat rigged.

The second sketch is a mast step that was used on the same boat. On several other sailboats trouble had been experienced in preventing the bottom socket of the mast from splitting out when any great strain was placed on the mast. To eliminate this difficulty, I took a piece of boiler flue, or pipe, of the correct inside diameter to fit the mast and cut out a U-slot in one end. This slot must fit snugly over the keel or stem where the mast is to be stepped. The other end is mounted through the regular timber in the deck. The pipe can be sawed off flush with the deck and a brass ring fitted around it to give a shipshape finish.—R. J. HEINEN.



An extra strong mast step made from pipe

MIXING LUMINOUS PAINT

THE convenience of finding an electric push button in a dark room is readily obtained by the use of a homemade luminous paint. The keyhole in a door is quickly found when the plate is similarly treated. Floats on fish nets may also be made luminous, as water does not affect this paint.

The paint is prepared by mixing one part of calcium sulphide *luminous* (in powdered form) with three parts of high-grade colorless lacquer. It should not be used on a surface already covered with oil paint, but on the original wood or clean metal surface. In the dark it does not fume like the phosphorescent streak from a match rubbed in the palm of the hand, but is nearly snow white. The luminous glow it gives off is similar to that of the radium-painted hands of a watch or clock. In daylight it looks like a creamy white opaque paint.

If it is mixed in the proportion of one part to two of lacquer, it is about 25 percent brighter than in a one-to-three mixture.

As the paint is not self-luminous, it does not glow when first applied, but must absorb light before it becomes visible in the dark. The lacquer makes the paint comparatively weatherproof, and even when wet it remains luminous.—H. M. PLAISTED, M. E.

HOW NEW KIND OF OIL ENDS LAST BIG CAUSE OF SLUGGISH MOTORS

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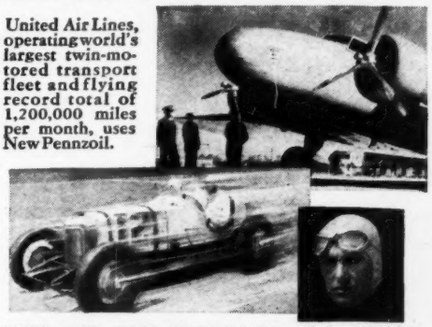
EVERY motorist knows how sluggish a new car gets after it has been run several thousand miles. Then, after its motor has been overhauled, and sludge removed from valves and piston rings, this same car *regains* power and speed.

New Pennzoil *ends* this loss of power—but in a *vastly better way*—because sludgy elements are *removed* from New Pennzoil *right at the refinery—before* the oil ever reaches your crankcase!

Result? With New Pennzoil, valve and ring repairs are reduced 75 to 90%. There is no sludge to cause valves to stick or rings to leak. And with sludge eliminated, New Pennzoil's tough film is *tougher*—doesn't burn up—cuts oil consumption up to 50%. Because valves and rings work freely, you save up to 15% on gasoline! New Pennzoil costs nothing extra. Ask for the correct grade for *your* car.

United Air Lines, operating world's largest twin-motored transport fleet and flying record total of 1,200,000 miles per month, uses New Pennzoil.



USES 55% LESS OIL! With New Pennzoil in his crankcase, Deacon Litz not only drove 500 gruelling miles over the Indianapolis Speedway at 102 miles an hour . . . but actually used 55% less New Pennzoil than *any* motor oil he formerly used for this run!

FAULTY LUBRICATION CAN RUIN YOUR CAR

At least 7 different lubricants are vital to your car—and Pennzoil "Safety System" dealers, who display this sign know how to apply them.

THE PENNZOIL COMPANY
Executive Offices
Oil City, Pennsylvania • Los Angeles, California
British American Oil Co., Ltd., Canada

TOUGH-FILM
New PENNZOIL
THE OIL THAT GOES FARTHER . . . FASTER . . . SAFER

Member Penn. Grade Crude Oil Ass'n Permit No. 2

BARGAIN!

Unusual opportunity to purchase latest model Royal Portable. New sales plan places this amazing new writing machine easily within reach of every reader of this magazine. Act quickly. Use coupon below.

BRAND-NEW GENUINE

ROYAL PORTABLE

WITH TOUCH CONTROL

Made and guaranteed by the Royal Typewriter Company, Inc. Anyone can use it—even a child. Will give lifetime of writing convenience. Here at last is the perfect typewriter for student, home, author—everyone!

TOUCH CONTROL... the most revolutionary improvement ever presented on a typewriter. Key-tension is instantly personalized to your own exact finger pressure.

PAY AS YOU USE IT!

Small down payment. Monthly terms easily arranged to suit your purse—only a few cents a day.

FREE! New system of touch typing. Prepared by experts. Quickly mastered.

FREE! Handsomely designed case. Typewriter easily removed for luggage.

SPECIAL FREE TRIAL

Try the New Royal Portable at home. If not entirely pleased, it may be returned without question.

SEND NO MONEY!

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2 Park Avenue, New York City
Please send me complete details concerning special FREE TRIAL OFFER on the New Royal Portable Typewriter with TOUCH CONTROL.

NAME.....
STREET.....
CITY.....STATE.....

Another **"CREATIVE WHITTLER"** *who uses a Remington*

"Bud" Blake carves caricatures for national magazines.

ASK the accomplished wood-carver or whittler for his secret of success, and he'll tell you: "It's a *good knife!*" You must have a knife that holds a razor-sharp edge... with blades of forged, high-carbon steel... with a comfortable handle... with rugged joints that don't work loose. "Bud" Blake and many others use only Remington knives. Try a Remington, and see for yourself!

Remington DUPONT

SEND 3¢ FOR WHITTLIN' BOOK

REMINGTON ARMS CO., Inc., Cutlery Div., Dept. F6 Bridgeport, Conn.
Please send "Things To Do With a Pocket Knife." I enclose 3c stamp.

Name.....
Street.....
City.....State.....

Folding Reflector Baker

FOR MAKING HOT BISCUITS AND CAKES IN CAMP

With this baker, you can watch your cakes to avoid burning

BEFORE you start on your next camping trip, spend an hour or two in making this reflector baker. You will be well repaid for the effort in nicely browned, hot biscuits.

Materials. Flat, bright tin, 13 by 42 in.; 11 ft. of iron wire, ⅛ in. in diameter (cut into six 12-in. pieces, two 9-in., one 30-in., and two 6-in., *not rolled);* ten ¼-in. iron rivets, and a baking pan about 1 by 7 by 11 in.

Tools. Scratch awl, tin snips, pliers, cold chisel, center punch, drill for rivets, file, and hammer.

Construction. Lay out tin as in Fig. 1 and cut on all heavy lines. The two slots in the 4-in. piece are made with the cold chisel and should be only as wide as two thicknesses of the metal.

Turn and finish the edges that are to be permanently wired. Then bend the tabs along the edges that are to be hinged (Fig. 2). Match the edges, insert the wires, and test the hinges. The ends or short sides of the 4-in. piece are bent up at right angles to the surface and in the opposite direction to the tabs.

Two of the 12-in. wires are pointed on one end, and a ring about 1 in. in diameter is formed on the other. These two wires are removable to allow the baker to be folded for carrying. The other hinge wires are retained in place by pinching the tabs on the ends.

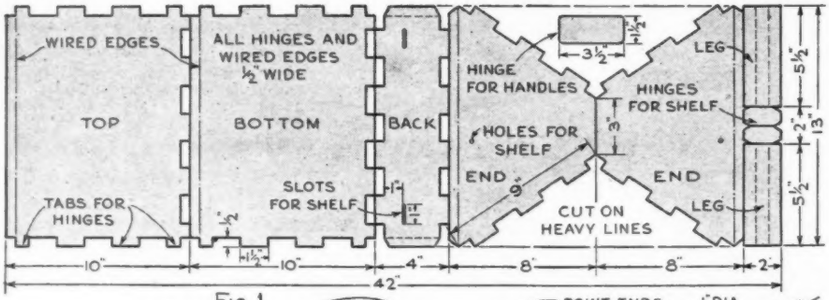
The 2-in. wide pieces of tin are bent into three thicknesses each and drilled and offset as in Fig. 5 to form the rear legs. Rivet these in place about 2½ in. from the sides of the back.

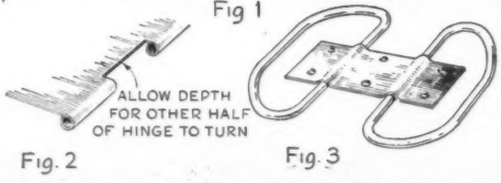
The support or shelf for the baking pan is made from the 30-in. length of wire as in Fig. 4. Bend two pieces of tin around the wire and pinch them together so that the ends can be inserted in the slots previously cut in the back. When the wire is down snug against the back piece, bend the ends of the small pieces over against the back and hammer down. Set baker in position, lift shelf until horizontal, mark position of wire points on sides of baker, and drill holes. Spring shelf apart slightly at front so that the wire will snap into the holes.

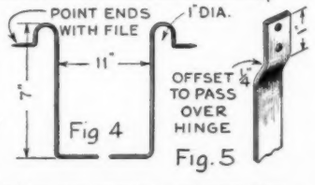
For convenience in handling baker when hot, a wire handle may be added to top as shown in Fig. 3.

Use. The baker depends upon reflection so it is important that it be kept bright at all times. A canvas or leather carrying bag will help to protect it.—LEONARD F. MERRILL.

The hinge tabs are bent over a piece of wire





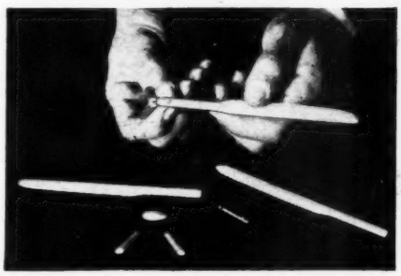


A pattern for the baker and details of hinges, handle, baking-pan support, and rear legs

SCALE MODEL OF NEW WINGLESS AUTOGIRO

(Continued from page 69)

After it has been assembled, the motor unit is fastened with cement to nose of fuselage



Each of the rotor vanes is riveted to the metal "Y" so that it can be swung backward

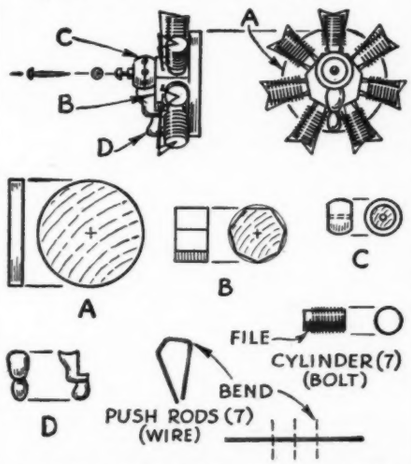
in the drawings, serve as axles for the wheels.

The engine is made as a separate unit with cut-off pieces of small bolts for the cylinders. When assembled, the engine is cemented to the fuselage, the front end of which is beveled so that the engine tilts downward as on the real autogiro.

An attractive color scheme for the model is yellow and tan or olive. The fuselage, horizontal tail, and vanes, for example, may be yellow; and all the struts, the rotor mount and "Y", the tail-support fin, vertical tails, and wheel disks, tan; and the engine, tires, and trim, black.

Note that the rotor vanes, as in the real ship, can be swung to point back over the fuselage. This is to save space in the hangar.

The new Pitcairn cabin autogiro, of which this is a model, is powered with an English Pobjoy engine, rated at 75 H.P. The plane takes off with a run of less than 100 ft., and the landing run is only a few feet. High speed is rated at 105 M.P.H.; cruising speed, 90 M.P.H.; and low speed, 17 M.P.H. A single lever is hung from the cabin ceiling for tilting the rotor in any direction, thus guiding the plane. The tail control is optional.



Assembly drawings of the motor and details of the parts. These are all shown full size

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All batteries tend to "go stale" if left overlong on dealers' shelves. But Eveready Batteries, which outsell all other brands, are sold so fast that we can put a dead-line date right on the label. Only FRESH batteries give long dependable service, so look for the "Date-Line" when you buy.

LOOK FOR THE "DATE-LINE"— IT GUARANTEES THEY'RE FRESH!

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Have you ever taken the wrong road and traveled many miles before discovering your mistake? This new AIRPLANE TYPE COMPASS constantly tells your direction of travel. Sticks to windshield. Base 1½" diameter. ONLY $1.95 POSTPAID, including Compensator. SATISFACTION GUARANTEED or your money refunded if returned within ten days.

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TRANSPARENT WATERPROOF

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Use quick-drying Du Pont Duco Cement to make your model stronger. Send green carton or red disc from 25c tube for free plan. DUPONT, Dept. A-2, Wilmington, Delaware.

DUPONT DUCO *Household* CEMENT

RATHER PAY FOR OIL OR REPAIRS ?

A study of the money Americans spend in maintaining motor cars suggests that most of us are penny-wise and pound-foolish.

In 1934, car owners spent 435 million dollars for motor oil. But, expenditures for *replacement parts and service labor* were 2 billion dollars—almost five times as much. (Automobile Trade Journal.)

If automotive engineers did not know any way to overcome this enormous cost of repairs, it could be accepted as a necessary evil. But they are agreed that the great majority of repairs are caused by *inadequate or faulty lubrication.*

The economy of good oil is even more apparent today than heretofore, because the wearing surfaces of the new motors have been fitted much more closely together and require a lighter oil to reach these confined spaces. And this light oil is subjected to greater *punishment* than ever before. As a result—the lighter the oil is, *the better it must be* in order to give your motor unstinted lubrication.

Thus, selection of the right oil is the first step in reducing repair costs. But no oil can last indefinitely. Since no positive way has yet been found to prevent the accumulation of dirt, dust, fuel residues, moisture, and minute metal particles in the crankcase, we recommend a complete drain and refill at regular intervals. Because even the best oil, *plentifully used,* is cheaper than repair bills.

That's why so many economically-minded motorists are saying today: "I can't afford repair bills, so I use Quaker State." Quaker State Oil Refining Company, Oil City, Pa.

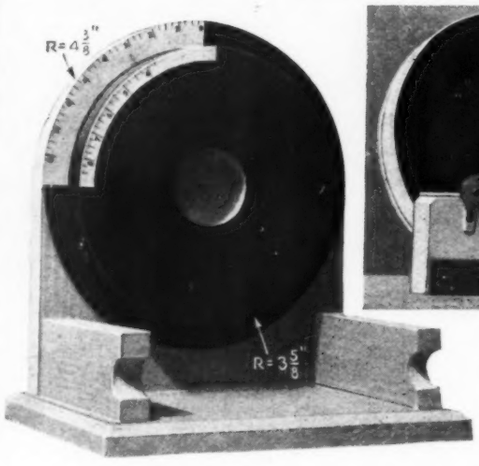
•

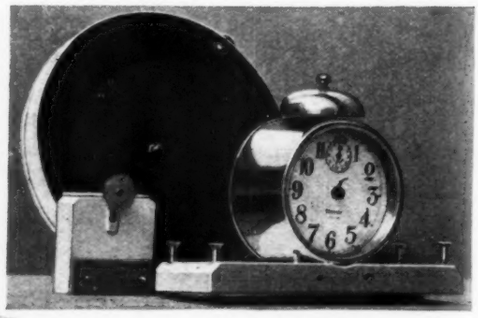
"First choice of Experience"

QUAKER STATE MOTOR OILS

SUNSHINE RECORDER COSTS LITTLE

(Continued from page 65)





The drum assembly is shown at left. Above is the inside of the cover, the bearing standard, and the clock. The hour hand is cut off and bent into a small crank which engages a hole in the gear when the parts are assembled

a heavy enough weight at the edge of the drum to cause it to revolve slowly—a trick that will remove the load from the clock and take up the play in the gears.

Now snip off the minute hand and reduce the length of the hour hand, bending it into a crank. Drill a small hole in the pinion gear and fit the hour crank into it.

Paint the drum and the inside of the cover flat black, and the rest some cool color. To clamp the ends of the blueprint paper, break 1 in. from each end of a worn hack-saw blade and screw these pieces to the drum below the horizontal diameter.

The two calibration quadrants are shown full size so they may easily be traced. The outer one is to be cut out and pasted on the inside of the drum standard flange, running from the left end of the horizontal diameter (drawn, for convenience in setting, parallel to the base), to the top—that is, to the vertical diameter. The inner quadrant is glued to the front of the drum in the same position, flush with the edge.

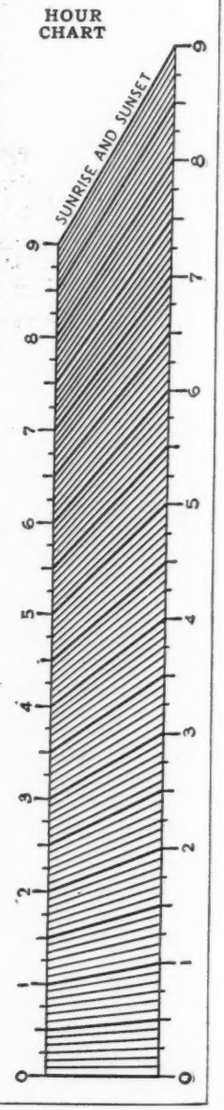
To run a test, rotate the drum cover as necessary by means of the clock hand-set, tilt back the hinged part, and clip on a strip of blueprint paper. This can be done in a subdued light, as the paper is not especially sensitive.

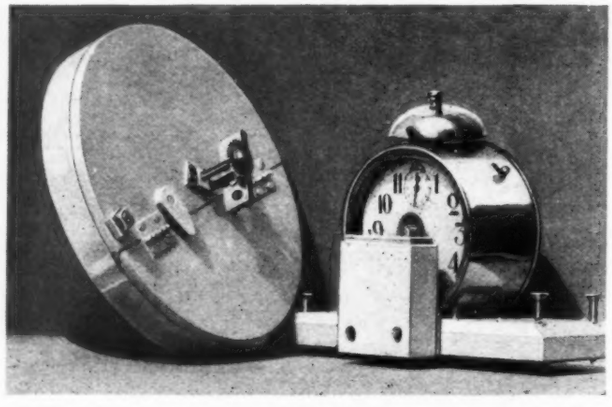
Now find out from the local paper the times of sunrise and sunset, or figure it from tables in a nautical almanac. Suppose that you live in Indianapolis and are taking the sunlight for August 14. The sun rises about 4:54, Central Standard Time, which is 7 hr. 6 min. before 12 o'clock, and sets at 6:45 P.M., or 6 hr. 45 min. after 12 o'clock. Total hours are therefore 13 hr. 51 min., and a half day is 6 hr. 55 min. Taking the O-point of the outer scale as midday, set the lens at 6:55.

Set the instrument up outdoors, tilting it until the back lies in the plane of the sun's apparent path. Block it up in this position and set it going. A small spirit level rested on the base chamfer will level it from east to west. After sunset bring the meter inside. Before removing the paper, mark the start of the day on it with pencil, also the midday point, using the drum scale. Flatten the strip on a table for marking the sunset point, which is as far as the sunrise from the midday point. Then wash in water and dry.

The strip can be read most easily by pressing it against a window pane, or a ground glass with a light behind it, so as to view it by transmitted light. A solid blue line will show

(Continued on page 81)





The outside of the drum cover with shaft, gear, and bearing; and at the right of it, the block to which the bearing is afterwards screwed

SUNSHINE RECORDER

(Continued from page 80)

along the outer edge of the strip, where light leaked between the edge of the drum cover and the support flange. The record appears as a cloudy smudge of blue, varying in density, with a fine, scorched line near the center, solid or broken, and fading out at each end.

To compute the total hours of sunshine, transfer these scorched dash lengths with dividers to a piece of paper. You can check the time by stepping off the hours with dividers.

A more convenient method is to use the accompanying full-size hour chart. The blueprint record should be folded lengthwise through the ends of the record and laid along the chart with the midday point at zero and with the sunrise or sunset point at the line indicating the correct number of hours from midday (that is, 12 minus the sunrise time, plus the sunset time, divided by 2). The intersecting chart lines between these two points show the time to the nearest five minutes.

If you wish to prepare your own blueprint paper, the following sensitizing solution may be used: 1 part ammonium ferricitrate and 4 parts water, brushed or swabbed on the paper; then 1 part potassium ferricyanide to 4 of water, brushed on. Dry in the dark.

COATING OF SAND MAKES DIVING BOARD SAFER

COCO matting for covering the end of a diving board is so expensive that I tried a substitute. This served satisfactorily for two months last year and gives every indication of being serviceable all this year. When it does wear out, however, it may be easily replaced.

My method is as follows: The board is not used for a day so that it may become bone-dry in the sun. It is then given two coats of spar varnish at the outer end. A third coat is finally applied, and on top of it, while still wet, fine beach sand is sprinkled through an ordinary kitchen strainer. When the coating dries, it is rough enough to prevent slipping, but not rough enough to hurt the feet, which is an objectionable feature sometimes found even with coco matting.—RALPH PAGE.

CARDBOARD DISK HOLDS CUT FLOWERS ERECT

TO HOLD one or two flowers erect in a tall vase, cut a disk of cardboard to fit in the vase near the mouth and punch a hole through the center of the disk. If the flower stem or stems are inserted through this hole, the cardboard will keep them centered in the vase and prevent them from tipping over.—N. V. D.

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9" x 3' "WORKSHOP" PRECISION LATHE

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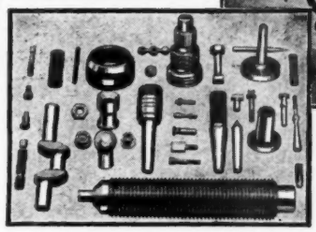
Features: Automatic longitudinal power feed to carriage, graduated compound rest, micrometer graduations on feed screws, ¾" hole thru spindle, No. 2 Morse Taper Centers, etc.

Send down payment for 30-day trial; money back if not satisfied. Immediate shipment.



9½" x 3' "Workshop" with Horizontal Countershaft, ¼ H. P. Reversing Motor, Reversing Switch and Belts. $94

$24 Down, $7 a Month for 11 Months.

At Left — Metal Parts Machined on 9" Workshop Lathe.

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Swing Over Bed	Length of Bed	Distance Between Centers	Ship'g Wgt. Lbs.	Net Factory Price	Ship'g Wgt. Lbs.	Net Factory Price
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9½"	3½'	24"	265	87	325	106
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WHO'D BELIEVE I WAS SKINNY AND LONELY A FEW WEEKS AGO

Thousands quickly gaining 5 to 15 lbs. new, easy way

DON'T think you're "born" to be skinny and friendless. Thousands with this new, easy treatment have gained husky, good-looking pounds—*in just a few weeks!*

Doctors for years have prescribed yeast for health. But this new yeast tablet discovery gives *double* results—health, and solid, new flesh—*and far quicker.*

Not only are thousands quickly gaining handsome pounds, but also clear, smooth skin, freedom from constipation, indigestion and nervousness, glorious new pep.

This amazing new product, Ironized Yeast, is made from special brewers' ale yeast imported from Europe—the richest yeast known—which by a new scientific process is concentrated 7 times—made 7 times more powerful. Then it is ironized with 3 special kinds of strengthening iron.

Day after day, as you take pleasant little Ironized Yeast tablets, watch flat chest develop, skinny limbs round out attractively, complexion clear.

Results guaranteed

No matter how skinny and weak you may be, this new Ironized Yeast should build you up in a few short weeks as it has thousands. If not delighted with the results of the very first package, money back instantly.

Special FREE offer!

To start you building up your health right away, we make this absolutely FREE offer. Purchase a package of Ironized Yeast at once, cut out the seal on the box and mail it to us with a clipping of this paragraph. We will send you a fascinating new book on health, "New Facts About Your Body". Remember, results guaranteed with very first package—or money refunded. All druggists. Ironized Yeast Co., Inc., Dept. 458, Atlanta, Ga.

Posed by professional models

BEWARE of a clogged radiator. It overheats the motor . . . saps power . . . leads to costly repairs. It's much better to prevent a clogged radiator than to cure it. But Sani-Flush will do either. Just pour in Sani-Flush. Run the engine. Then drain. (Directions on the can.) Sani-Flush is perfectly safe. Cannot harm aluminum cylinder-heads, nor cooling-system. It is non-caustic. Use Sani-Flush at least twice a year. It costs only a few cents.

Most women keep Sani-Flush in the house to clean toilet bowls. But if you can't find it, buy a can at any grocery, drug, or hardware store—25c and 10c sizes. The Hygienic Products Co., Canton, Ohio.

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Don't be a wallflower. Send for Free Booklet and Free Demonstration Lesson. These explain our wonderful home study method fully and show you how easily and quickly you can learn to play at little expense. Mention your favorite instrument. Write NOW.

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Harmony and Composition	
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GUILD CLUBS DISPLAY THEIR WORK

(Continued from page 61)

Three winning projects in Lincoln Club show: Checkerboard table by C. E. Booth, table by J. J. Buck, wastebasket by A. Bietz

Shenango Valley Homeworkshop Club, Sharon, Pa. The first annual exhibition was held in the Sunshine Home. There were many unusual exhibits, including replicas of machinery and furniture used in Colonial days, lamps, toys, hammered copper and brass, inlaid work, stamps, old coins, antique furniture, clocks, firearms used in the Civil War and World War, spinning wheels, and a small racing car. Michael Bebech was awarded the Popular Science Craftwork Medal as grand prize for a small table inlaid with pictures of George and Martha Washington. Among the prize winners were Richard Murphy, R. C. Martz, Edward A. DeMuth, T. A. Davison, Roy Marx, John A. Bock, Percy Sellers, Charles Fornander, Eric Holmgren, Ernest Hanson, and R. T. E. Bowler.

Topeka (Kans.) Homeworkshop Club. The club coöperated in a large bird-house contest for boys and donated ten dollars' worth of tools for prizes. C. B. Campbell, Fred Jepson, and Guy Hovenden represented the club on the general contest committee.

Chicago (Ill.) Premier Homeworkshop Club. Sterling MacDonald, designer of three Union Pacific streamlined trains, gave a talk at a recent meeting on how a modern train is designed, tested, and operated. He extended an invitation to all members to visit his laboratory, it being necessary merely for them to show their Guild membership card. It has been found that carrying a Guild card gives an amateur craftsman many advantages and opens many doors to him that otherwise would be closed.

Miss Betty Scott operating the marionette theatre at the National Guild Exhibition

Spanish Lake Homeworkshop Club, St. Louis, Mo. Meetings of this newly organized club are held the first Friday of every month and the members are preparing projects for a fall exhibition. Model railway locomotives, bird houses, model airplanes, gasoline engines, a submarine, and other projects are under way. Besides the usual officers, the club has a publicity manager, an official photographer, and an assistant photographer.

Tucson (Ariz.) Homeworkshop Guild. The club now issues a monthly bulletin, compiled by the secretary. It is intended to keep members informed of club activities and to preserve in some form the information provided by the club's question and answer bureau. . . . L. S. Raymond recently gave an unusual demonstration on the construction of typewriters and adding machines. . . . The club has decided to hold a social meeting at least once every two months. In most cases these will be dinners, followed by brief addresses.

Newcastle (Calif.) Homeworkshop Club. In order to purchase power tools and other equipment, the members are coöperating with the Lions Club of Newcastle in a play.

Chickasaw Homeworkshop Club, Memphis, Tenn. No sooner was this club formed than plans were made to have the members bring in projects that could be placed on exhibition in a show window. . . . A lecture on bookbinding was given by B. B. Jones.

Capital Homecraft Club, Washington, D. C. The members met recently at the home of Edward Houck, Alexandria, Va., who demonstrated an air compressor built from odds and ends and displayed some interesting antiques.

Three Rivers Homeworkshop Club, Three Rivers, P. Q., Canada. J. C. Boissonneault, the president, exhibited a three-in-one table made from plans published in POPULAR SCIENCE MONTHLY.

Peekskill (N. Y.) Homeworkshop Club. A demonstration on pewter work was given by Thomas Dore.

Prize projects in Morristown (N. J.) Club's exhibition: Dresser, J. W. Fear; chair, H. Myers; enlarger, V. Pike

WATER SPORTS CREATED BY OUTBOARD MOTORS

(Continued from page 52)

water into a six-inch chop. Then the boats skate from wave to wave.

Sometimes, when the drivers are shooting over the water at express-train speed, they speed up the little engines to 5,000 and 6,000 revolutions a minute. The spark plugs take most of the punishment at such speeds. They are flashing half a hundred times a second, three times as fast as those of an aircraft engine.

THE longest outboard race ever run in America was held in the Middle West, a few years ago. Starting from Chicago, the contestants followed the Illinois River to the Mississippi and the Mississippi to New Orleans. Seven of the little boats completed the 1,750-mile run, the winner averaging twenty-two miles an hour for the journey.

On river races, floating debris is a constant hazard. During one St. Louis, Mo., regatta, so much drifting brush and timber filled the Mississippi that the meet was called the Driftwood Derby. This year, the whole distance of the Hudson River course was patrolled by yachts, cruisers, and rowboats operated by people living on the shore. They picked up driftwood and stood by ready to help racers in distress. In addition, a plane with a loudspeaker circled overhead, ready to summon aid for contestants stranded on sandbars or capsized in midstream.

At the top of the list of queer causes of grief is one which befell William Rozette, three years ago. His boat had tire trouble in the middle of a river! Twenty miles from the finish of the race, he was skimming along at nearly forty miles an hour when he struck a floating automobile tire, covered with moss and almost invisible in the water. Before he could cut the switch, the whole lower part of the propeller housing had been ripped away, leaving him drifting with a useless power plant.

In another long race, one driver became confused in a fog and found himself meeting boat after boat headed in the opposite direction. In his confusion he had circled around and was speeding back toward the starting point. At the finish line, another racer failed to see the judges' stand and rushed on at top speed for several miles before he realized the race was over.

Even more nerve-tingling than the long races, are the half-mile-course events with thrills and spills at almost every turn. In the early days, riders sometimes thrust a fist into the water on the near side of the boat to help swing the craft in a tight turn around the buoy. Speeds are far too great for that now, but the skillful racer of today knows just how to adjust his weight and cut the motor in order to jockey safely around any turn.

ONE of the most daring closed-course racers in the world is the California girl, Loretta Turnbull. She began racing at fourteen and at the end of three years had captured fifty-six trophies. Her father and two brothers are also outboard fans. At their summer home in the foothills of the Sierras, forty miles from the nearest body of water, the Turnbulls have a boathouse! Here they putter with hulls and motors when they can't be practicing on the water.

As an example of how the sport of outboard racing has spread, consider the special water track which has been dug in Texas. This wide, oval ditch, five feet deep, provides a course for the speeding hydroplanes while spectators watch from the grandstands just as at an ordinary race track.

In other places, tiny racers have circled in large swimming *(Continued on page 84)*

Did You Ever Feel Like WHITTLIN'?

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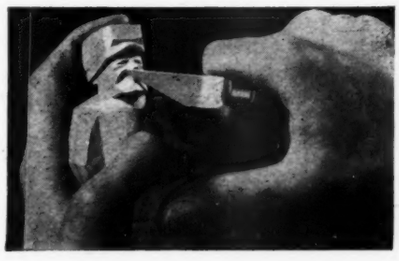

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WATER SPORTS CREATED BY OUTBOARD MOTORS

(Continued from page 83)

pools or have engaged in games of tug-of-war. Shuttle races and relay events are outboard features on many programs. In one recent contest, the little boats rushed full-speed at a sloping bank, the prize going to the one that could slide farthest up on land. The tilting feature of the motors made this contest possible.

IT ALSO permits the spectacular "leaping Lena" exhibitions in which a boat shoots up a greased platform and leaps for as much as thirty feet over the water. Two of the best-known outboard stunt men are Malcolm Pope and Reginald Brown. They jump through flaming hoops, barrel-roll like a corkscrew in specially designed craft, ride standing on their heads while steering with cables, and balance themselves Cossack-fashion on two boats at a time.

Thrilling as such stunts are, they are far less dramatic than real-life rescues accomplished with the aid of outboard engines.

When a night flood inundated a large part of North Sacramento, Calif., a few years ago, the owner of an outboard boat drove his little craft up one street and down another, rescuing stranded citizens. All night long, the engine kept on the job. By morning, it had propelled more than 300 people to safety.

Quite as dramatic was a performance, two years ago, on Lake Superior. Ralph Anderson, a trapper on Isle Royal, rode his open boat in pitch darkness across the white-capped water, filled with floating ice, that separated him from the Michigan mainland and brought a doctor to a stricken companion. His little outboard motor carried him through without a miss.

It is such exhibitions of reliability, as well as spectacular performances in speed, that demonstrate how far these power plants have gone in their short quarter century of existence.

SEES WILD LIFE DOOMED

WILD animals are doomed to destruction by mankind, and within a few centuries there will be none left in the world, predicts Dr. James L. Clark, vice-director of the American Museum of Natural History. The larger animals, he foresees, will be wiped out by hunters; the fish, by polluted waters and disturbance of their breeding places. Even birds will eventually disappear. Domestic and tamed animals will be the only survivors of this dramatic chapter of the earth's evolution, Dr. Clark declares, except for low forms of life that will live on indefinitely in the depths of the seas. These will continue as before to evolve into other forms, but not large ones; for as their size increases, so does their mortality at the hand of man.

BOTANISTS USE BOATS TO EXPLORE TREETOPS

USING a boat to collect rare orchids from treetops was the recent upside-down adventure of Dr. Carroll W. Dodge, leader of a botanical expedition to a Panama jungle. The feat was made possible by recent erection of the Madden Dam of the Panama Canal, forming a lake that all but submerged a tropical forest. Paddling about in canoes, the botanists were able to reach easily sections hitherto accessible only by arduous trips along paths hacked through the dense jungle, and to study treetop plants that would otherwise have been far out of reach. So far as records show, this is the first time botanists anywhere have had such an opportunity.

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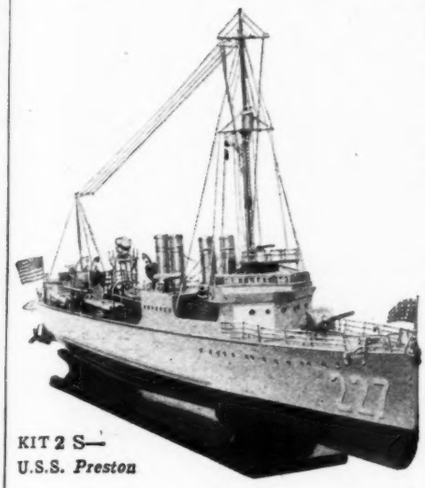
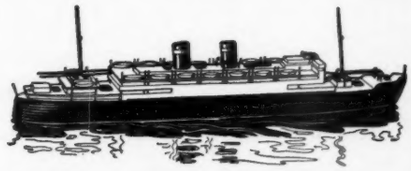


KIT 2 S—
U.S.S. *Preston*



KIT X—A 12½-in. model of S. S. *California*

KIT 1M—An illuminated show-boat model

ILLUSTRATED directly above is a 31½-in. scale model of a United States destroyer for which a special construction kit has just been prepared. It is an unusually decorative model that has long been popular with our readers, and the new kit is being offered in response to many requests. The hull lifts are sawed to shape and all necessary raw materials are included for only $5.95, postpaid (50 cents extra west of the Mississippi River).

The complete list of our construction kits is as follows:

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D. Spanish galleon, 24-in..... 6.45*
DD. Same with hull blocks shaped 6.95*
E. Battleship U.S.S. *Texas*, 3-ft. 6.95*
EE. Same with hull lifts sawed 7.45*
G. Elizabethan galleon *Revenge*, 25-in. 6.75*
GG. Same with hull blocks shaped.... 7.25*
L. Farragut's flagship *Hartford*, a steam-and-sail sloop-of-war, 33½-in. hull..... 7.95*
LL. Same with hull lifts sawed..... 8.45*
Q. Privateer *Swallow*, 12½-in. hull, with lifts sawed to shape..... 4.95†
V. Clipper *Sovereign of the Seas*, 20½-in. hull, with lifts sawed to shape..... 4.95†
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2S. U. S. Destroyer *Preston*, 31½-in. hull, with lifts sawed..... 5.95*

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J. Clipper ship *Sea Witch*, 13-in..... 1.50

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S. S. S. *Savannah* (first steamship to cross Atlantic), 3½-in., and S. S. *Atlantic*, 6-in. (two models in one kit) ..... .75
T. U.S.S. *Brooklyn*, armored cruiser in Spanish American War, 8-in..... .75
U. *Hispaniola*, the ship in "Treasure Island," 7-in..... .50
X. S. S. *California*, 12½-in... 1.00
Z. H.M.S. *Bounty*, 11½-in... 1.50
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No. 6. Solid rock maple butterfly table, top 19 to 22 in., height 22½ in. Ready to assemble and stain included..... 6.90*

No. 7. Whittling kit with two shaped blocks for making sea captain 5½ in. high..... 1.50

NOTE: If you live west of the Mississippi River, add 50 cents to all prices marked with an asterisk (*) and 25 cents to all prices marked with a dagger (†). Otherwise all prices are postpaid anywhere in the United States. The kits marked with an asterisk or dagger will be sent C.O.D. upon request, but the purchaser will have to pay 28 cents additional.

NO. 2

NO. 5

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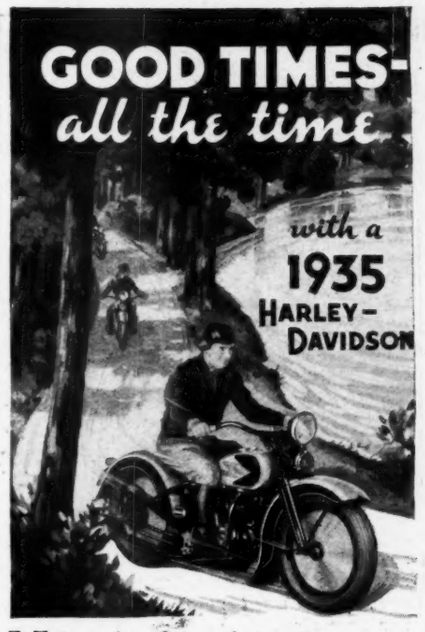

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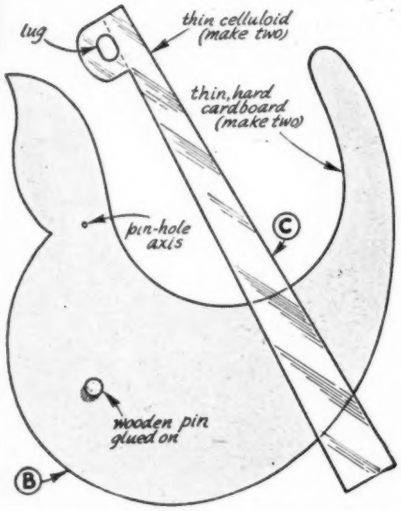
HOW TO MAKE A CAMERA FOR YOUR MICROSCOPE

(Continued from page 41)

face. Such cardboard is often used for the covers of cheap note books. Printers also use it under the name of pressboard. The shutter blades and base plate can, however, be cut from playing cards with the upper surfaces blackened with waterproof India ink. An extremely smooth surface is necessary so that the shutter blades will slide on each other, and on their base plate, with a minimum of friction.

The shutter springs *(C)* are made from any convenient piece of thin sheet celluloid. I used a piece that was serving as a window in a package of large needles. The shutter pins *(D)* are simply bits of round toothpick fastened to the shutter blades with glue.



Full-size patterns for the shutter blades and springs. The blades are made of smooth fiber cardboard, the springs of thin sheet celluloid

The opening movement of the shutter is caused by the crowding apart of the scissors-like blades by a strong needle *(E)* fastened into the end of the trigger lever. This happens as the trigger is pressed back, moving the needle forward. When the trigger is released, the trigger lever is drawn forward by the rubber-band spring and the celluloid shutter springs push the shutter blades closed.

If the patterns of the shutter blades and shutter springs are carefully followed, you will have no difficulty in making a shutter which will close quickly and positively when released.

Now that our camera is complete, let us try it out by taking a flash-light snapshot of some little pond creature. Place two or three drops of pond water, with a few shreds of green algae floating in them, in a well slide on the stage of your microscope. The construction of a well slide was described in an earlier issue (P. S. M., Feb. '33, p. 46).

THE light sources should be arranged as shown in the photograph. The pull switch (screwed into one side of a double socket) is off and a photoflash bulb is screwed into its socket. Light the small ten- or fifteen-watt bulb in the other side of the double socket so that its rays are thrown up through the miscroscope by the mirror.

After locating a field containing some promising creature—vorticella, rotifer, or what not—focus the image carefully on the ground glass and replace the glass with a film pack. With the shutter of the camera closed, pull off the pack's safety cover.

All is ready for the exposure except the subject. With your eye to the viewing tube, manipulate the focusing screw of the microscope to keep your subject in focus. If it suddenly leaves the field, shift the slide on the stage a little and follow it, if possible. Or find another subject. When it is finally quiet and in focus, quickly, but gently, open the shutter trigger with your left hand and turn the current into the photoflash bulb with your right. Then instantly release the shutter trigger and allow it to close the blades.

IF YOU find a subject which is firmly attached to a filament of algae (and relatively quiet) you need use only a ten-watt frosted bulb instead of the photoflash, making a quick time exposure by pressing back and releasing the shutter trigger. A fifth to a half second is enough. You will find it better to stick to the lower powers of your instrument at first (100 diameters or less) as the amount of light coming through to the film is weakened considerably by using the higher-powered objectives.

Probably one of the most fascinating photographic stunts to be done with a microscope is the taking of movies. For this, you must have some kind of motion-picture camera. This is not, however, an adventure to be undertaken until you have mastered the technique of taking "stills" as just described. After you have had some good results with this photoflood or flash method, you can advance confidently into the movie field.

The strip of film reproduced was taken by the author with an old-fashioned hand movie camera (using standard thirty-five-millimeter film) but it could have been done equally well with sixteen-millimeter equipment. It is not, however, advisable to experiment with eight-millimeter cameras. The adjustments are too small.

The technique differs from that of "stills" only in that you cannot focus on a ground glass placed in the plane of the film but must measure the distance between the film plane and the camera front, after removing the lens. With this measurement, you can arrange your focusing attachment so that your first experimental shot flashes will be fairly sharp. After taking them, mark with a pencil the point on the inner tube *(J)* to which it is pushed in.

To increase the sharpness of your pictures, the following steps should be followed: Put any mounted specimen slide under the objective. Adjust the camera with the lens tube *(H)* pushed all the way into the empty lens socket. Focus on the screen at a point where you tried the first experimental flashes. Pull out the focusing tube *(J)* slightly and refocus. Turn on the flood light and take a one-second flash. Mark the point on the tube *(J)*. Then push the tube in very slightly beyond the mark where the original flashes were tried, and take another short flash. Also mark this on the tube. When the roll of film with these experiments on it is developed, you can determine at which of the three experimental points the tube *(J)* should be permanently glued into a fixed focus.

AS IN every other phase of craftsmanship, perfection comes only to the persistent. At first, your hunting of live creatures in the microscopic jungle may include more misses than hits, but even then you often will be rewarded by some beautiful snapshot—perfectly caught and in focus. As you become more and more at home with your equipment, your average will get better and better, until you have the satisfying album of enlargements from your negatives which is the goal of every photomicrographer. And when you give a little show of microscope movies, you can be sure that your audience will be thrilled.

SIMPLY MADE BOILER

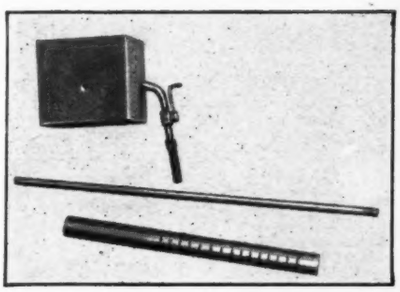
(Continued from page 68)

over plug. With a pin, pull a portion of the asbestos wool out through each of the slits in burner tube to form wicks. These wicks should be about ⅛ in. long. The burner tube is held in position by the bracket and clip shown.

The fuel tank is simply a small sheet brass tank or a can of suitable size. Insert a small shut-off cock between fuel tank and burner.

Operation. Open shut-off valve, allowing the fuel, which is alcohol, to run down into the burner. The size of the flame may be regulated by the valve.

If used in a boat, the fuel tank may be located in any convenient place so long as it is higher than the burner. Boiler and engine



The ⅛-in. burner tube with wick slots, the ⅛-in. feed tube, and tank for holding fuel

should be so placed as to make the distance from the boiler steam outlet to the engine as short as possible. A small globe steam valve should be inserted in steam line between boiler and engine. The photo of the entire power unit shows the engine connected to the boiler by a length of rubber tubing. At 25-lb. pressure this is entirely satisfactory where flexibility is desired in making tests and adjustments and in experimenting with the unit. Thick-walled rubber tubing of the type used on auto windshield cleaners is satisfactory.

This type of boiler can be altered slightly for high-pressure use in a speed boat on short runs by adding a water gauge and substituting a gasoline burner of the blowtorch type. By a few experiments with the throttle wide open, it can be determined just how much fuel can be used at one filling without exhausting the water supply.

PHOTO DEVELOPERS KEPT COOL WITH DRY ICE

DURING hot spells it is necessary to control the temperature of photographic developers. A glass tube, about 6 in. long, a rubber cork with a single hole, and a supply of dry ice are all the materials that are needed. Fill the tube with dry ice (varying the amount to regulate the temperature as desired) and insert the rubber stopper. Put the tube in the developer with the top of the tube projecting above the surface of the liquid.

This device can also be used for hypo and other liquids, and will prove more convenient than the usual method of adding ordinary ice to the solution.—MARTIN GRANOFF.

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"Before the advent of home study", says Dr. Noffsinger, "success for the unschooled man was problematic. Anything beyond a mere living was practically out of the question for the wage earner who, through lack of means, misguided judgment, or force of necessity had been deprived of the benefits of a formal education. Lack of early scholastic training is no longer a fatal handicap. Home study has removed that barrier which was once almost insurmountable, so that today any man with a sufficient urge to get out of the rut, or away from the blind alley job in which he finds himself, may do so if he wishes. The home study school offers the solution to his problem.

"There are also in the busy marts of trade and commerce thousands of high school and college trained men who are called upon to perform technical and executive duties for which they lack adequate special training. For such and others aspiring to definite positions of responsibility, the home study school offers an opportunity for thorough instruction.

"Home study is the medium by which they may bring recognition and greater accomplishment within their grasp. It is by far the most satisfactory method yet devised for the great group of people who must prepare themselves for larger success while they continue working.

"The value of training depends on its application. Is home study practical? Go into almost any business organization, any bank, any commercial house, any shop, mill, or factory in America today and ask the question of the officers in charge, or of the workers. A surprisingly large number of them will confess that their own success is due in a great measure to spare time study in the quiet of their homes.

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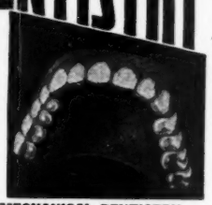

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"Keep in mind the fact that many a successful artist and musician learned in the quiet of his own room the fundamental principles of his art, and applied those principles in the developing of his present skill. Remember that many a salesman, that many an accountant, many a tradesman and countless thousands of other men and women who have successful businesses of their own, learned in their spare time as you will learn.

"The home study school has a distinct place in the world's educational system. Texts specially adapted to the student who studies alone, cooperation that serves his needs best, instruction of a peculiar type, to say nothing of the encouragement, the inspiration and the constant effort on the part of reliable schools to bring about the advancement and greater success of their students are among the facilities offered by the reliable schools teaching by the home study method.

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"Most people take up home study because they see in it an opportunity to make themselves more efficient and therefore more capable of earning a larger income. Thousands have testified to the securing of such results. This aim of securing more money is entirely a praiseworthy one, yet there are other benefits conferred by it which may be of even greater value to the student. Among its *greater* gifts, home study builds character.

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Secrets of Success

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WHO SHOULD ENROLL?

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"Among the various groups which could most obviously profit by home study are the following:

1. Young men and women who have finished school, but now being employed, see a definite goal ahead and home study as the direct means of reaching it.
2. Men and women who are deprived of the opportunity of going to school when young.
3. Young men and women who are ambitious but who cannot stop working to go to school.
4. Employed men and women who want to better their present conditions . . . who need technical or specific training for their present line . . . or who want to get out of a rut or blind alley, perhaps by changing entirely their business, trade or profession.
5. Men and women who want to keep abreast of the times, and to retain and add to the general culture already received in school and college. Home study recognizes no age limits.
6. High school and college graduates who want to continue special training for advanced technical or executive positions.
7. Men of junior and senior executive rank, who realize the need of constant refreshing on the fundamentals and newest developments within their field.

BUSINESS ENCOURAGES HOME STUDY

"There are probably more than three quarters of a million students, mostly adults, enrolled each year in one or more of the numerous home study courses which are now available. These students may have enrolled either because of their own desire to utilize leisure time for advancement or they may have enrolled at the suggestion of their employer. The attitude of modern business toward home study courses is shown by the fact that more than 5,000 industrial and commercial corporations, including railroads, banks, manufacturing concerns, department and chain stores, etc. have some kind of contractual relation with various home study schools for the purpose of 'up grading and training' their employees."

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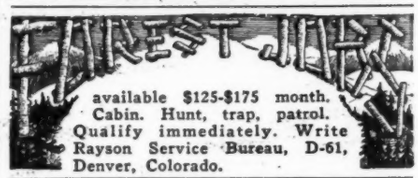

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BUILDING SURF BOARDS

(Continued from page 57)

varnish, rubbing well with steel wool after each one except the last.

Bear in mind that this type of board is not expected to take punishment on rocky shores or on gravel, because the balsa is easily dented.

The laminated redwood-and-pine board shown in Fig. 2 is similar in appearance, although it differs somewhat in construction, having air cells cut in the solid wood. It is put together with ¼-in. dowels and two 5/16-in. bolts with countersunk heads and nuts, as illustrated. Casein glue is used between the joints. Care must be taken when planing the assembled unit that you do not cut through into the air cells. This board should be varnished in the natural wood. Apply about four coats, and rub the first three, when dry, with steel wool.

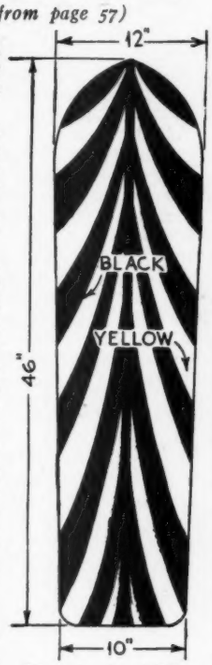

Fig. 5. A child's board for paddling

The curved-head or toboggan type of board is illustrated in Figs. 3 and 4. This is adapted to ordinary surf in shallow waters, but is not intended to be paddled far from shore, as may be safely done with the others. It is a favorite with concessionaires at public beaches. As will be noted in the drawings, the fore ends of the pieces, one of which is shown in Fig. 3, are not bent, but are cut from straight stock. As the two outer pieces are 1½ in. wide, they obviously must be band-sawed from stock that thick, and 4 in. wide. All of the ten inner pieces are grooved, as shown, to reduce the weight. Dowels, casein glue, and two bolts are used in the assembly. This type of board also looks best if finished in the natural wood with spar varnish.

The child's paddle board, Fig. 5, is made from a single piece of white pine or redwood. It should be ¾ or 1 in. thick. Two or three ⅜-in. dowels or ¼-in. brass rods will lessen the danger of splitting. This type of board lends itself to striking decorations, and it is a good idea to paint an unusual pattern with bright colors, as suggested in Fig. 6.

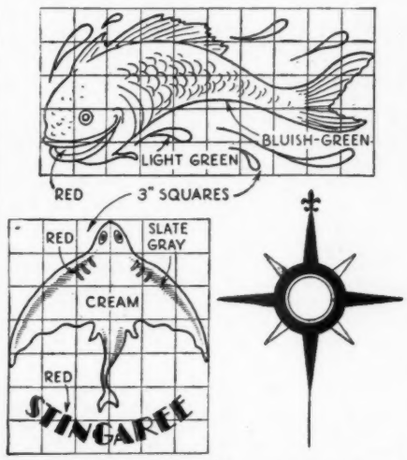

Fig. 6. Designs for decorating surf boards

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ELECTRICITY FROM OCEAN TIDES

(Continued from page 11)

Island while recuperating from an illness, Franklin D. Roosevelt, has given the word that is making Cooper's vision come true.

And in its coming true, the father of the Passamaquoddy scheme sees dramatic possibilities affecting human welfare as well as engineering advancement.

For decades, the population in the region of Eastport has been dwindling. Small industries have been dying out, and people have been moving away. With the possibilities of large amounts of cheap electric power and a harbor that is 300 miles nearer to Europe than any other in the United States, Cooper believes chemical and metallurgical plants will be attracted to the region and a vast industrial center will develop, bringing prosperity and new life to Northern New England.

THOUGH Cooper's scheme is the first to be tried out on a large scale, other plans for tapping the power reservoir of the sea have been proposed and, on several occasions, have been tested with small, experimental plants. In fact, one French author lists no less than eighty-eight proposals which have been made for using the tides to operate mills. As early as 1790, a small tide-power mill was in operation on the River Tamar, in England.

In general, four classes of proposals have been advanced. In the earliest, a heavy, floating body was to be lifted by the rising water and, in descending, was to accomplish work through a system of gears and pulleys. In the second type of scheme, a raft was to be anchored in the tidal stream and equipped with paddle wheels. As the tides ebbed and flowed, the raft would be turned to face the moving water, which would spin the wheels and produce practically continuous power. Neither of these proposals could be applied in large-scale projects.

Compressed-air reservoirs formed the heart of the third class of proposals. Rising tides would compress air into great containers and this compressed air would furnish power when needed. The fourth group, and the only one practical for large developments, is the high-basin reservoir scheme to be used at Passamaquoddy.

A curious variation of this idea was recently tested at the Avonmouth Docks, at Bristol, England. Paul Shishkoff, a London hydroelectric engineer, designed the 300-horsepower plant with which experimental data is being assembled. In his scheme, excess power is stored as heat.

WHILE the tide spins his turbine and generates current, a brake on the shaft produces heat by friction and raises the temperature of the water flowing over it to 390 degrees F. This heated water is stored in an insulated tank where it remains under pressure, its temperature being equivalent to 200 pounds gauge pressure of steam. When the tide is low and current is needed, the pressure is reduced, part of the superheated water turns to vapor, and this operates an ordinary steam turbine. In preliminary tests, the inventor reports, the combination plant has functioned perfectly.

In the plans of other engineers, tide-power turbines would be combined with plants burning coal or oil. On the coast of Brittany, in France, a proposal is under serious consideration to develop a combined river-and-tide hydroelectric project

The first step would be the building of a 490-foot dam across the estuary at Aber-Vrach. The plant would contain four turbines, developing 1,200 horsepower. They would operate on both incoming and outgoing tides. Four miles away, on the river Diouris, a second dam would provide a fresh-water reservoir that would turn the turbines of an auxiliary plant. The two projects, complementing each other, would supply continuous current.

By far the hugest of all tide-harnessing schemes to be given serious consideration is one upon which a Government commission has just reported favorably in England. It proposes a gigantic 1,224,000-horsepower development in the estuary of the Severn River. Here the tides are among the highest in the world.

As they rush into the estuary, they mount vertically into a bore, or solid wall of water, that advances for miles up the river. The largest bore known occurs in the Chinese river, Tsien-tang. Pouring in from the China Sea, it passes Hai-ning in a wall of water ten feet high, preceded by a cascade of bubbles and foam.

To tap the power of the Severn tides, an immense dam, three miles long, will have to be constructed. Just as in the Passamaquoddy project, excess current will be used to pump water into a huge reservoir. This storage basin will have a capacity of 1,431,000,000 cubic feet and will be located on the River Wye, eight and a half miles from the tide-power plant.

During the seven years the commission studied all phases of the Severn project, a fifty-foot model of the estuary, complete with channels and sandbars, was constructed and tested at Manchester University. Special machinery sent water rushing up the miniature estuary just as it does at flood time. To study the effect of the proposed dam on navigation and to discover the best type of barrier to use, the scientists kept the model under constant observation for nearly five years.

ENGINEERS point out that the dam across the estuary would create a new roadway between important industrial centers, cutting fifty miles off the present route and supplementing the railroad facilities now afforded by the Severn Tunnel. Benefits also would accrue to navigation on the estuary through the improvement of harbor and dock facilities.

While the plan is still but a vision, it has been approved by a scientific commission, and there is a possibility that work on the project may begin in 1937. Fifteen years, it is expected, would be needed to complete the gigantic undertaking.

All along the West coast of England, the tides run high. This fact has given rise to an interesting suggestion. J. O. Boving, a British hydroelectric engineer, points out that places only 130 miles apart, by air line, are as much as 900 miles apart by water, due to the winding of the coast line. High tides reach one point as much as three and a half hours after they have reached the other. He proposes a series of interconnected tide-water plants.

As the plants would have their periods of peak production at different times, one could take up the load when the other began to slow down, thus sending out over high-tension wires a continuous supply of current. This scheme would make high-level reservoirs, or other storage places for excess power, unnecessary.

At the present moment, in widely separated parts of the world, engineers are tackling the problem of harnessing the ebb and flow of ocean water. The time when tide-power will be an established factor in industry is close at hand. With work already begun at Passamaquoddy Bay, a vision of pioneers is rapidly moving from a realm of dreams to a world of actuality.

MAYAN THROWING STICKS

(Continued from page 55)

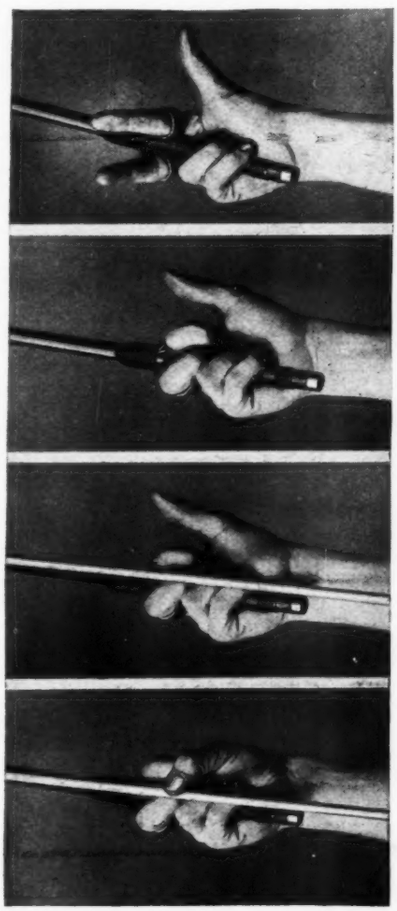
serves as a peg. The second stick is whittled from white pine, and the peg is a wood screw, which is rounded with a file after the head has been cut off. Slightly more elaborate is No. 3. It has an ebony peg, and there is a dowel pin through the handle for a finger rest. Cord is wrapped around the stick in two places for decoration.

Still better are the sticks marked Nos. 4, 5, and 6. These are made of maple and have turned ebony, bone, or maple pegs. They are painted in various colors and decorated with cord wrappings, leather fringes, and feathers, and have leather loops for the fingers. All three sticks can be cut from a piece of maple 5/8 by 3 by 30 in., as shown in a diagram near the end of this article. The stock for the handles is 5/8 in. square. The heads may be cut to any desired design and the handles rounded off and dressed down to about 1/2 in. round. The sticks are then sanded, stained, and polished.

The peg in each case is about 1/4 in. in diameter, with a ball formed on the end. A ball will follow the concave socket in the arrow through a greater length of stroke than a plain, straight point. The peg may be set at any angle from 45 to 80 deg.

Glue the peg in a hole drilled in the head. Attach the finger loops and decorations with wrappings of cord such as chalk line. Pull the ends through under the wrappings to avoid knots. The wrappings may be stained with water colors and shellacked when dry.

Although arrows from 28 in. to 5 ft. in length may be used, the standard 28-in. target or hunting ar- *(Continued on page 95)*



Method of grasping the stick and placing the arrow, which is held lightly with the thumb

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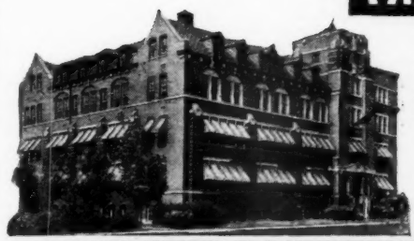

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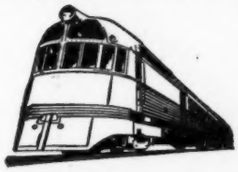

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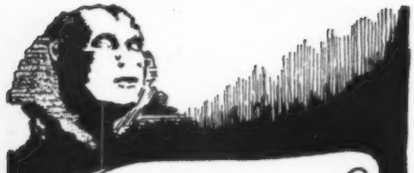

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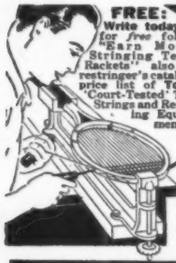

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POISON MURDERS SOLVED BY TEST-TUBE SLEUTHS

(Continued from page 13)

are paralyzed in the voluntary and respiratory muscles. The heart continues to beat, but breathing through the skin is difficult. The same paralysis is noted in man and other warm-blooded animals.

Curare comes from the *Strychnos* family of plants, as does strychnine *(Strychnos nux vomica)*. However, strychnine is a tetanus-producing drug, causing violent muscular convulsions. A strychnine victim's body is arched in a bow while tremors ripple the muscles. Curare, on the other hand, produces quite the opposite effect, paralyzing the muscles.

STRYCHNINE itself was used in the 1933 "poison-picnic" murder in Arkansas. It was administered in grape juice and, strangely enough, the beverage was taken by the four victims without their noticing anything unusual about it. Strychnine is extremely bitter, one part in 70,000 parts of water being distinctly noticeable.

A man, his wife, and two of their children were killed in this case by an attorney who feared the father was going to "squeal" on him in connection with a shady case. A third child lived and told of seeing the attorney "put something" in the grape juice. The "something" turned out, under qualitative tests, to be strychnine.

Poisons fall into distinct chemical classifications. Acids and alkalies form the first group. Among the former are such substances as sulphuric and hydrochloric acid. Among the latter are caustic potash and ammonia, with others. The metallic poisons like lead, silver, mercury, copper, arsenic and thallium salts are in a second group. Thallium sulphate was the poison fatal to five members of a New York family in May of this year. In this case, chemical analysis revealed the poison in cocoa used by the family. The gaseous poisons form another group and include the familiar carbon monoxide, five tenths of one percent of which in stagnant air can prove fatal. This means that in a garage of 200 cubic feet, one cubic foot of carbon monoxide would be fatal. Other gaseous poisons include hydrocyanic or prussic acid, chlorine, and others.

Hydrocyanic acid is swift in its action, one to two and one half grains being sufficient to cause death. It evaporates quickly, and a mere whiff of the fumes can bring death with dramatic quickness—but not with the speed mystery-story writers claim. Like all other poisons, hydrocyanic acid has different effects upon different persons and a Philadelphia College investigator is on the alert for the complications that often arise as a result.

A MAN could swallow hydrocyanic acid and, in the few seconds before death ensued, toss the bottle out the window, walk to a chair, and sit down. The odor of bitter almonds or peach blossoms, so stressed in mystery stories, would indicate the acid as the cause of death, but only the trained investigator would consider suicide when no bottle was found in the room. He would make a search outside the room, at least.

Nicotine, conine (which is the poison hemlock swallowed by Socrates), alcohol, ether, chloroform, formaldehyde, and allied compounds fall into a fourth group of volatile organic poisons. A miscellaneous group would include nitrobenzene, phenol (carbolic acid), and the aniline dyes, among others.

Substances seldom classed as poisons by the public, such as alcohol, chloroform, and ammonia, are included in the toxicologist's category, for anything capable of being taken into a living organism and causing by its own action impairment of the organism's function is a poison.

For this reason, the culture of septic-pneumonia bacteria used in the Indian case was classed as a poison. An interesting side light on that particular murder is the fact that the conspirators, who sought the victim's death so that his estate might be inherited by them, tried first to kill him with tetanus bacilli which were rubbed on the bridge of his spectacles.

POISONS in the several groups act in three ways. They are irritants, blood poisons, or nerve poisons. Pain, vomiting, and purging are produced by the irritants. In the blood poisons, the circulation is affected directly, the red corpuscles are destroyed, or the drug has a peculiar action on the coloring matter or decomposition products of the blood. The nerve poisons include the narcotics or stupefying drugs, those producing delirium, and those causing convulsions.

The scientific investigator knows the probable effect of each poison through experiment and experience and can identify them at the autopsy and later check in the laboratory. Tests on the lower animals help. Frogs are quite useful in determining the effects of poisons. The poison is injected into a frog's lymphatic gland and the heartbeats, respiration, and voluntary and involuntary movements are studied.

The examination of bloodstains plays an important part in scientific crime detection. While distinct from the forensic analysis of poisons, tests to reveal whether a blood spot is animal or human, or even to prove that it is blood at all, are often vital factors in the prosecutor's case.

Many factors enter into the study of bloodstains—the material on which they are found, their age, and the condition of the material to which the blood adheres. Blood will form a compound with iron oxide, for instance, if found on rusty iron. Greasy cloth makes a bloodstain look like any other discoloration. The composition of bricks or plaster must be considered.

If there is a quantity of fresh blood, as in a pool, it can be tested for grouping—that is, compared with the four types of human blood and its animal or human origin determined. Or it can be placed under the microscope and the red and white corpuscles, which differ in humans and animals, identified.

If a stain is blood, there is a positive test that will reveal it as such. After the stain has been soaked off the cloth, wood, or other material holding it, chemicals are added to the solution and, if it is blood, the haemoglobin in it will crystallize into haematin crystals. These are readily identified under the microscope as chocolate brown needles, usually four-sided.

SEVERAL chemicals, benzidene, ortho-tolidine, guaiacum, and phenolphthalein, turn definite colors when hydrogen peroxide is added to them in the presence of a solution containing a trace of blood. All but the phenolphthalein become a beautiful blue color, while this exception turns red. These tests are so responsive that they reveal blood when it is present in only one part to 500,000 parts of solution.

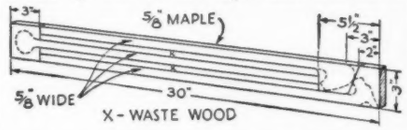
The precipitin test makes use of serum from a rabbit which has been immunized against the type of blood to be tested. This is used to distinguish different kinds of blood. A rabbit immunized with chicken's blood will produce a serum that will react only when in contact with chicken's blood. If immunized with human blood, the serum is the proper reagent for only human blood. The investigator tests many kinds of prepared serums, in tubes containing blood solution. The right one liberates the coloring matter of the blood, while the others do not.

MAYAN THROWING STICKS

(Continued from page 93)

rows obtainable at any sporting-goods store are probably the most practical. It is necessary merely to cut off the nock and form a round concave socket to match the rounded end of the peg. If you wish to make your own arrows, you will find instructions in any standard book on archery.

The method of gripping the stick is illustrated in the accompanying series of four photographs. The second, third, and fourth fingers grasp the handle, while the first finger is folded up out of the way. Place the arrow



An economical way to cut three sticks from one small piece of maple or other hardwood

socket on the peg and lay the shaft along the first joint of the second finger, holding the shaft in place with the thumb. Use only enough pressure to keep it from falling off.

Stand with the feet apart, the left foot forward and pointing toward the target, the right foot back and at right angles to the left, unless, of course, you are a left-handed thrower, in which case the position is reversed.

Draw the stick with the arrow in place straight back over the shoulder and execute a straightforward overhand swing. At the finish of the stroke, rock up on the right toes. Do not try to release the arrow with the thumb, as it is not necessary. If the thumb is pressed lightly against the arrow, but not lapped entirely over the top, the release will take place without conscious effort and at exactly the right time.

The throwing stick is by no means a toy. It has a range up to 500 ft., and the power is sufficient to inflict serious injuries. Use the same precautions as with archery. Be especially sure to have plenty of room when you first try out the sport. An archery target is the most convenient to use, but any type of target in which the arrows will stick may be used.

Do not allow children to use the throwing sticks unless under adult supervision. If you regard it as a weapon and use reasonable care, you will find it quite safe and will soon develop considerable accuracy. Continued practice will bring greater skill and increasing enjoyment in this unique and healthful sport.

SCREW THREADS IMPROVE BEACH UMBRELLA

IT OFTEN takes considerable strength to push the end of a beach umbrella far enough into the sand to make it hold firmly, especially in a strong breeze. To make the pointed end enter the sand more readily, simply cut or file a coarse screw thread on the end—something like a gigantic wood screw. The stick can then be turned into the sand with little effort. The same expedient can be used when it is necessary to drive other long wooden poles into the sand or earth.—S. A. FRITSCH.

OLD BALL BEARINGS ACT AS COASTER WHEELS

Boys' coasters with a very low center of gravity can be made by using discarded automobile ball bearings and their races to serve as wheels. The outer race acts as the rim of the wheel, and the inner race is merely bolted to the axle or driven over the end of a wooden cross member. A coaster of this type rolls well on the sidewalk or driveway and hugs the ground so closely that it cannot very well tip over.—N. D.

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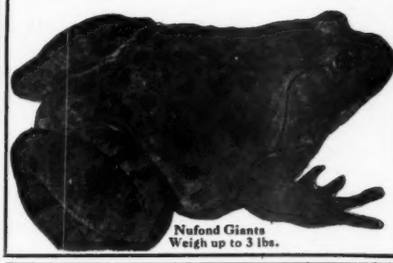

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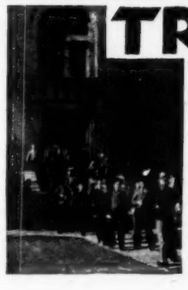

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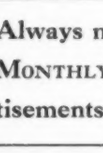

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MACHINES SHOW WONDERS OF THE HUMAN BODY

(Continued from page 36)

each flash of light that illumines an organ in the transparent man, a label in the base of the pedestal is lighted up to identify the organ. An automatic switch operates the lamps in an orderly sequence, starting at the brain and working down through the whole body.

At the switchboard of the speech exhibit, you turn the little metal pointer to "3," and see just how we understand the spoken word. A tiny light flashes in the ear and travels to the brain center for hearing, thence to the word-sound center, and, finally, to the comprehension centers of the brain.

In another exhibit, a little hammer strikes a seated manlike model below the kneecap. The spectator sees the electric shock as it travels up a nerve in the back and down another nerve from the spine to the leg muscle. The model's leg kicks out, just as that of a real person does when tapped below the kneecap. Here light and motion explain the phenomenon of reflex action.

PULL down a lever and let go quickly. A rubber lung shows the action of the human lung as it expands and contracts in breathing. In another corner, finely wrought metal joints, patterned precisely after the different joints in the human body, portray the action of the smoothly working hinges in our arms, legs, and hands.

How is it we can twist our heads in almost any direction? Enclosed in a glass case is the answer. A wire outline of a human head is fixed atop a mechanical joint that is a replica of the joint that supports the human head. Operate the levers, and the wire outline nods and twists on its metal joint just as a living head moves on its bony pivot.

The largest exhibit in the Hall of Man is that showing the circulation of blood in the body. This huge display has a glass heart whose valves, modeled after the valves of the human heart, open and close just as they do. An external pump forces a colored liquid from the chambers of the heart, through tubing that parallels the flow of blood in the human body, and back again to the heart chambers.

Do you want to take apart a head and torso? Come to the "body books," sets of wooden pieces, two inches thick, carefully carved and colored to be perfect copies of the human head and torso. These body books are in vertical upright sections and in horizontal cross sections. Simply by moving the levers, one separates, piece by piece, the head and torso into its component parts.

WHY do we differ, physically? Lights flash on to show the glands of internal secretion, the homes of the hormones, those mysterious chemicals that fix and hold fast our physical fates and destinies.

Sound production in speech is portrayed vividly in light and action. Press down one of the levers. The model's lips, tongue tip, front and back parts of the top of the tongue, and lower jaw, all swing into lifelike motion to show the mechanics involved in making but one particular type of sound.

The X ray, radium, and photography unite to enable us to take a picture of the interior of the entire human body with but one exposure. The radiograph, as it is called, is on exhibit in the Hall of Man. The clear picture it gives is invaluable in medical diagnosis, infallibly searching out a broken bone, a swollen appendix, a cancer, or almost any other maladjustment of the human machine.

All life begins in a single germ cell which divides and redivides itself until, in the human machine, it has located its subdivisions in three layers. An exhibit shows the original cell, typical subdivisions, and what parts of the body are built from each layer.

HERE'S THE ANSWER

(Continued from page 53)

the files have been etched sufficiently, remove from the solution, wash well in water, dry, and oil to prevent rusting.

How to Clean Tent Canvas

S. P., NEW ORLEANS, LA. Mildew can be removed from a tent by sponging the canvas with a weak solution of calcium hypochlorite, or bleaching powder. Be sure to wash the solution out well after using.

Iodine in Human Body

O. E., NEW HAVEN, CONN. The average human body contains about twenty milligrams of iodine. About half of the body's iodine is contained in the thyroid gland, a ductless gland located below the pharynx.

Testing Tennis-Racket Strings

Q.—HOW can real catgut strings in a tennis racket be told from the imitation or silk variety? I would like very much to know, as I am an amateur racket stringer.—P. A., Saulte Ste. Marie, Mich.

A.—FRAY the end of the string for a short distance and endeavor to light it. If it burns, the string is silk; if not, gut.

Source of Second Wind

Q.—WILL you please explain what happens when a runner gets his "second wind"?—B. F., Cincinnati, Ohio.

A.—WHEN a runner gets his "second wind," it indicates that his body is getting the increased supply of oxygen it needs through a compensating adjustment of the heart rate to the intake and outgo of air in the lungs. Prior to this point, he was trying to supply his body with the needed oxygen by rapid and heavy breathing.

Saving a Cracked Dish

Q.—I HAVE a cracked dish which has a great sentimental value to my family. Is there any inexpensive way in which I can protect it from further deterioration?—R. L., Richmond, Va.

A.—IF THE dish is boiled in sweet milk (enough to cover) for forty-five minutes, the cracks will adhere together and most of them will become invisible.

To Prevent Sweating Pipes

W. A. S., HARRISBURG, PA. Pipes can be prevented from sweating by coating them with pulverized cork. To do this, first clean the surfaces of the pipes thoroughly and then paint them with red or white lead paint. While the surfaces are still wet, apply the pulverized cork. When the paint has dried, the cork will be firmly embedded and this cork covering can, in turn, be painted. The cork layer acts as a heat insulator and prevents the cooler pipe from coming in contact with the warmer surrounding air.

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D. C., SAN ANTONIO, TEXAS. Pills made of metal and precious stones were in common use in the seventeenth century. A popular variety made of antimony and known as "everlasting pills," was believed to be a cure for "cramps and contractures of the nerves." Pills containing such ingredients as powdered emerald, ruby, topaz, and sapphire were administered for the same ailments. Such pills, of course, were absolutely insoluble and had no curative powers. Some users may have benefited by purely mental reactions.

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TESTS SHOW STRANGE FACTS ABOUT WATER

(Continued from page 45).

Meker or Fisher type, if available, will work better, because it produces a much hotter flame. The end of the coil should not be far from the zone of heat, so that superheated steam will issue at the end without being cooled too much by passing through unheated tubing.

WHEN the generator is set up and running, hold a piece of lead foil in the invisible vapor issuing from the coil. The foil will instantly melt. Ordinary wire solder, held in the vapor, flows like water. Paper is instantly scorched by the superheated steam. A cigarette can be lighted as easily as if a burning match were at the end of the tube! Using water to light a smoke should prove a mystifying trick to try on your friends. By holding other substances in the superheated vapor, an experimenter can devise his own favorite demonstrations. When substances do not actually become ignited in the vapor, it is not the lack of a sufficiently high temperature that will usually be responsible, but the fact that the water vapor blankets off oxygen that would be required for combustion. To avoid failure in these experiments with superheated steam, make sure that the copper coil is heated sufficiently.

The purification of water by precipitation can be strikingly shown with the aid of some clay, two small glasses or beakers, and a pinch of ordinary household alum. First rub a small amount of the solid clay into some water to form a paste. Drop this clay paste into a glass of water, pour the resulting suspension of clay into the empty glass, and continue pouring the solution from one glass to the other until each glass contains the same amount of clay suspension. These two glasses of milky liquid then will serve as your two test specimens.

Set both glasses aside and in one place a drop or two of alum solution. Do nothing to the other. After several hours—or, better still, the next day—examine both glasses carefully. The clay contained in the glass to which the alum was added will have settled to the bottom, while the liquid in the second glass still will be milky. Like the clay, all suspended matter will have been precipitated out from the alum-treated water.

WATER also can be tested easily to determine how much dissolved air it contains. The water to be examined is placed in a flask corked with a rubber stopper fitted with a single glass tube leading to an inverted and stoppered test tube. This in turn is connected through a second glass tube to an open tumbler or beaker of water.

At the start, the entire apparatus should be filled with water so that no bubbles of air can be present. The flask is then heated. Any air dissolved in the water is freed and passes up into the inverted test tube where it is collected. As the heat expands the water, the excess is caught in the tumbler of water.

You will be surprised at the volume of air that will collect in the test tube. By marking the tube with a piece of string or a rubber band at the point where the air begins, the amount of air can be measured at the end of the experiment by filling the tube to this point with water and then pouring the water into a graduate or measuring flask.

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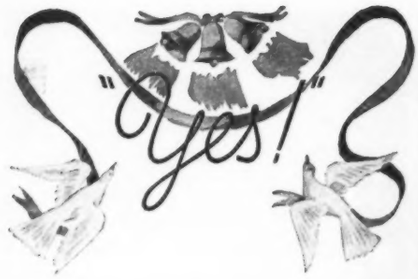

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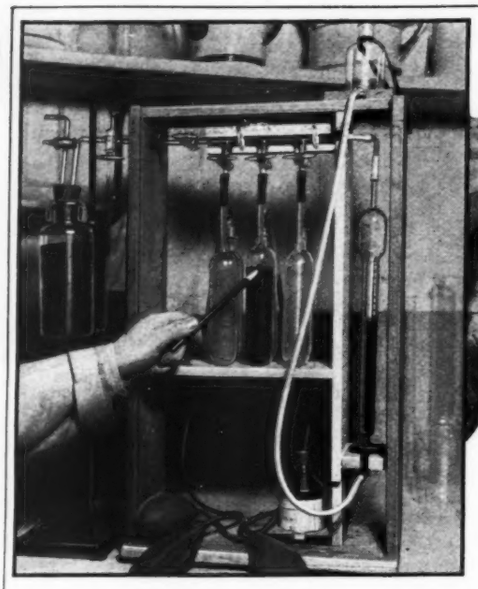

The apparatus at the left is used in analyzing gases given off by coffee. Above is a twig of a coffee bush with berries

A Better Cup of Coffee

(Continued from page 19)

they have no pleasing aroma and produce a bitter, unpalatable beverage that is drunk only by a few tribes in the region of Sumatra.

Seventy percent of all our coffee comes from Brazil. Whole lines of steamships ply between the two countries carrying nothing but coffee beans on the north-bound trips. Special precautions are taken to keep strong-smelling cargoes from entering the holds on voyages south. Green coffee readily absorbs and holds any unusual odor. Spices, hides, fertilizers, and certain chemical substances are never carried in ships that transport coffee.

When a coffee ship steams into New York Harbor and ties up, the first man down the gangplank is the captain's runner. Under each arm, he carries a stack of flat tin cans containing samples of the cargo. They are rushed to consignees on Coffee Row. In half an hour, they have been examined and tested, the hatch covers on the vessel are off, booms are swinging out bags, and the green beans are on their way to the warehouses and to many of the 2,500 roasting and packing plants in the country.

Many of these plants represent the last word in scientific machinery. One plant in the East turns out more than 100,000 pounds of packed coffee a day. In cleaning the raw coffee, the machines remove a surprising array of odds and ends: safety pins, pebbles, sticks, coins, cartridges, trouser buttons, screws, and garnets and other semi-precious stones. Many plants have permanent collections of the queer things taken from the machines.

DIFFERENT sections of the country have different preferences in the matter of coffee blends. All retail coffees are blended, or mixed, to produce desired combinations of mild and acid coffees. In Southern California, a mild, Mexican blend is favored. In the Northwest, a more acid beverage is wanted. In New England, the "Boston roast," a cinnamon-hued product, is popular, while in New Orleans and the lower Mississippi region, a black, charcoal type is most in demand.

In such blends, the rare Sumatran beans are frequently used. They grow on special plantations and are aged from eight to ten years before they are roasted and sold. Aged coffee loses much of its weight, but the increase in price more than makes up for the difference. The beans must age in the country where they grow. They cannot be stored in the United States for any length of time without becoming woody and losing its value.

In blending coffees, we usually employ Santos, from Brazil, as the base. Other famous varieties are the pungent, spicy Mocha from Arabia, the aromatic Blue Mountain coffee of Jamaica, and the mildly acid Bogota of Colombia. Coffees usually get their names from the ports from which they are shipped or the centers where they are collected.

USING special porcelain-china cups and silver spoons, we prepare the sample cups for testing. The coffee is sucked into the mouth while it is so hot we could not possibly swallow it, a half a teaspoonful at a time, in such a way that the liquid is atomized and sprays all over the mouth and throat. From practice, our sense of taste has become so acute that we can taste a crack in a china cup!

If there is a chip or crack in a cup, coffee enters and is not all washed out. This rancid, oxidized material affects the next brew placed in the cup and the coffee taster can instantly detect it. I have found that I can tell the difference between two cups of brew if one has hardly more than one tenth of a teaspoonful more coffee in it than the other. Hardly any of the liquid is swallowed in the work of testing. Sometimes, I taste as many as fifty different brews in a single forenoon. Then I go out and have coffee with my lunch—and enjoy it!

To aid in studying the aroma rising from a cup of test coffee, I have designed a curious device with curved glass tubes. This aromascope carries the vapors directly from the cup into the mouth and nose. Other aids to testing and blending are a colorimeter for matching shades of color, an Orsat-Muenke gas-analyzing apparatus, a hydrometer for determining the amount of solids in a brew, and a new laboratory apparatus which I designed to analyze and produce blends.

Such equipment helps to find the answers to common mysteries in the realm of coffee. Why is boiled coffee spoiled coffee? Why can't coffee be cooled and reheated without ruining it? Why are metal coffee-making devices less satisfactory than those of porcelain or china? Why is pulverized coffee spoiled? Why is a drip coffee maker better than a percolator? Questions like those are the ones science is now answering.

For generations, an adage of experts has been: "Boiled coffee is spoiled coffee." But nobody knew exactly why. Now we have discovered that the *(Continued on page 99)*

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HOW SCIENCE GIVES YOU A BETTER CUP OF COFFEE

(Continued from page 98)

instant the water begins to boil, a chemical change takes place in the brew. Oxides are precipitated and the flavor is changed.

Again, we have solved the mystery of why coffee is never good if it has cooled and been reheated. About one fifth of the weight of ground coffee is composed of waxy, resinous, insoluble fats. Cooling and reheating the coffee melts these fats out into the brew, spoils the flavor, and makes the drink less palatable.

Not long ago, the U. S. Bureau of Standards made photomicrographs of the insides of a number of metal coffee-making devices. Invisible pockets and fissures showed up like craters and canyons under the microscope. In such minute pores, coffee collects and turns rancid, just as it does in a crack in a china cup, and affects the flavor of the brew produced later on.

WHY does pulverized coffee prove unsatisfactory, while finely ground coffee produces excellent results? The answer is simple. In pulverizing the beans, the grinding mechanism heats and oxidizes the fine particles and imparts a bitter, acrid taste.

In recent years, a great deal of research has been carried on to find the best grind of coffee. In the old days, a very coarse grind was favored. Recently, with the rising popularity of the drip coffee maker, finer and finer grinds have been introduced. They expose more of the cells where the aromatic oils are stored and result in a finer-flavored beverage. Giant machines, with four sets of rollers, each pair cutting the coffee into smaller pieces, are part of the equipment of many mills. They turn out particles cut with almost mathematical exactness.

In one test, I found that the same amount of beverage, with the same flavor and richness, could be made from thirty cents' worth of fine-ground coffee as from $1.20 worth of of a coarser grind. In another experiment, I discovered that out of every thirty-cent pound of coffee a housewife puts in a percolator, she throws away four cents' worth in saturated grounds. The brew passes through the coffee several times, the last time leaving it saturated with the beverage. In the drip coffee maker, the water passes through only once and leaves clear water in the spent grounds.

IN CONCLUSION, let me pass on ten tips for making good coffee.

1. Avoid metal coffee-making devices. Use, whenever possible, a china, glass, or porcelain drip coffee maker.
2. Always use fresh coffee, finely ground.
3. Never boil coffee or reheat it after it has cooled.
4. Always measure water and coffee exactly. Don't guess.
5. Watch the clock. Coffee becomes bitter if it stands too long on the grounds in a pot or passes over them too many times in a percolator.
6. Use filter paper or porous stones to keep the insoluble fats from entering the brew and provide sparkling clarity.
7. Wet the basket of your coffee maker before putting in the dry, ground coffee. This prevents fine bits from passing down into the brew before the particles clump together.
8. When the brew in a drip apparatus is ready, swish it around before you pour it out. Otherwise, the weakest coffee will come out first, the strongest last.
9. If you use a percolator, turn the heat low so the water will percolate slowly. Five minutes is long enough to leave it on the fire.
10. In making iced coffee, the best results are obtained by freezing coffee into cubes and melting it with hot coffee rather than by chilling hot coffee with cubes of ordinary ice.

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Killer Ships of the Whaling Fleet

(Continued from page 29)

continued after a moment's pause, "he ought to be up any time now."

"What do you mean, 'good' whale?"

"If he stays under ten minutes or longer," he explained, without turning his head, "we can't get up to him before he blows and submerges again. If less than ten minutes, and we're not making any noise, such as a knock in the engine or a slack stern bearing, we usually can be alongside when he comes up."

He went on to explain another peculiarity in whale hunting. "Never cross a wake," he said. Somehow whales, either through their ears or by a sixth sense, seem to know when any large object crosses their wake, and take off on a new course.

ASIDE from our conversation, I could hear no sound which might race through the sea to warn our prey of our proximity. We were paralleling his wake now at half speed. The whale had blown twice since we began to follow his track. The little ship was edging in closer.

"A little more," called out the lookout.

Our speed increased by two knots.

"Is he coming up?" the gunner asked.

"He's coming up—slow," replied the man in the tops.

We still could not see the mammal from our lower position. The gunner stood at the gun, alert and ready.

"Is he coming up on the shot?" he called, a moment later.

"He's coming up on the shot," came the reply from above.

Then I saw the huge bulk, ahead and off the port bow no farther distant than twenty fathoms. The gunner stood silent now, motioning to the wheelsman to swing the ship slightly to port. We were moving dead slow, almost at a standstill, rolling slightly. Gunner Dedrick was sighting down the cannon, holding steadily on the target.

"Bang!"

Propelled by 550 grams of black powder, the heavy explosive harpoon, carrying a full pound of blasting powder, leaped from the muzzle of the brass cannon. Behind it trailed heavy rope which slipped from a neat pile at the gun mount.

"Is he fast?" asked the gunner, even before the last noise of the shot died away.

"Fast fish," replied the lookout, who already was racing down the rigging to the winch in preparation for playing the whale until his carcass should be pulled alongside.

As he spoke, I heard—or, rather, felt—a distant explosion. It was the bomb exploding deep within the whale, fired by a time fuse five seconds after it had left the gun. The gunner had scored a clean hit, so necessary when black powder is used to propel these deadly projectiles. Oddly, I learned, 210 grams of smokeless powder will discharge the harpoon sixty feet a second faster than more than twice the amount of black powder, but it can be used only in breech-loading guns.

BECAUSE of its lower velocity, a harpoon fired by black powder must score a clean hit. If it strikes the water as far as six inches from the whale, the shot is wasted; on the other hand, harpoons propelled by smokeless powder are effective when they strike ten feet away from a whale. Their velocity and weight are so great that they plow through the water like a torpedo to strike the prey.

Sometimes, a harpoon will plunge entirely through the whale and explode on the opposite side in the water. Again, there is the possibility that it may strike the sea and bounce as high as forty feet, missing the whale entirely and threatening to fall back on the ship to explode among the crew with fatal effect.

Seldom does a 100-ton whale tear the harpoon from its line; or break the line itself, for that matter. For the harpoon, whose steel leg is split in the middle like an elongated eye, is tied to a line measuring four inches in circumference by means of fifteen turns of Swedish-steel fence wire. Fifty fathoms of this line are coiled on the pan in front of the gun. This, in turn, is spliced to the main line, a 450-fathom length of sea rope which passes through sheaves on the bow of the ship, through a spring block which takes up the shock of sudden jerks, and around the steam winch.

Here I saw the perfect maneuver, the perfect shot, the perfect kill. Entirely unaware of our presence, the giant sulphur-bottom seemed to shiver under the terrific explosion, then commenced to blow in his agony. Where, before, water had been spouted, columns of blood now rose twenty feet into the air and fell back into the sea. The columns became progressively shorter, until, after five or six minutes, the whale expired and lay motionless.

Ten minutes after the shot was fired, the monster was alongside. The harpoon had entered immediately behind the right flipper, the most vulnerable spot on the large body. Little wonder the terrific explosion made the carcass ready for the pressure cooker without a struggle. An eighty-two-footer, weighing more than eighty tons, it was a victim of man's superior cunning and power.

BUT a single whale is not considered a day's hunting when others may lie ahead and time permits hunting for them. Usually, Captain Dedrick explained, smaller whales are lashed alongside the killer ship and towed during the search for more victims. But an eighty-ton sulphur-bottom hanging onto the little whaler was too much to drag around the ocean several hours, so we staked him out.

A seaman stepped to the rail and plunged a gigantic hypodermic needle into the whale's side. Soon the pumps were filling the body cavities with compressed air to keep the carcass afloat. Next, with all the force of two brawny arms, the sailor plunged into the flesh a steel spike bearing a twenty-foot pole at the top of which fluttered a red flag, bearing in the center a single white initial—proof to all that the owners of the *Hawk* claimed all rights and title to the derelict. At the base of the pike he secured a waterproof battery, to supply current for a lamp at the pole's top.

THROUGHOUT the rest of the day, we sailed steadily into the setting sun. Not another whale did we see, nor did we sight the other killer ship. At dusk, Captain Dedrick gave the order to turn about, and we retraced our invisible path toward the California mainland. At midnight we paused long enough in our voyage to pick up the prize we had staked out. With the whale lashed tightly against the side, we steamed at half speed through the early morning hours, reaching the *California*, riding at anchor in Pyramid Cove, as the morning sun broke over the cliffs of San Clemente.

The *Port Saunders* had beaten us in during the night with two blue whales lashed hard against her sides. Not a bad day's hunting—some 200 tons of blubber and meat.

When we pulled up to the *California*, I climbed over the side and onto the factory deck, where sailors with the aid of winches pulled the three whales alongside, moored them by their tail ropes and, one by one, swung them into position near the ship. Meanwhile, free of their loads, the killers put back to sea, retracing their tracks of the day before toward the feeding grounds some fifty miles to the west.

Two flat-bottomed flensing skiffs were lowered from the factory ship. In short order, a turning wire was attached to the inboard flipper and passed under the first whale, a seventy-six-footer brought in by the *Port Saunders*. As the flensers proceeded, cutting strips of blubber from the carcass, the winch pulled the whale slowly over. Each strip, measuring four feet wide and nine inches thick, ran the length of the body. The blubber stripped, two heavy wire slings were lowered; one was attached around the neck, the other around the body midway between neck and tail. Aided by the cut of the wires, a meat cutter severed the whale into three pieces. These three heavy sections then were lifted from the sea and deposited on deck.

Butchers of the deep sea, standing on the slippery platforms, completed the job of cutting the whale into relatively small parts, the meat moving on into the factory, the blubber passing to the boilery, consisting of a series of cylindrical boilers for reducing the fat to oil.

Blubber strips were cut in pieces and shoved down chutes to a blubber cutter. These small squares were pumped through pipes to the boilers, where for eight hours they would cook until the last ounce of oil had been drawn off.

MEANWHILE, the carcass disappeared, as meat, jaw, and backbone were fed into other boilers for cooking, which would continue for eighteen hours.

At the end of that time the sulphur-bottom which spouted so peacefully only a day before, would stand in a hundred barrels as oil and meal.

How much longer will the world's supply of whales last? Some whaling captains with whom I have talked believe they will be extinct for commercial purposes within a decade. Captain Dedrick thinks whales will be found as long as powerful fleets search for them. He estimates the whale population of the North Pacific to reach at least a million. Only in small areas of the Arctic and Antarctic have they been hunted intensively.

When Jordan Stops Flowing

SUN CRACKS spread over the salty clay bed of the lower Jordan River, in Palestine, when summer heat dries up the stream. Here the valley lies 1,200 feet below sea level